Phase 4: Project Report

Total Maximum Daily Load for San Lorenzo River Estuary and Carbonera Creek Pathogens in Santa Cruz County, California

DRAFT

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1. PROJECT DEFINITION

1.1. Introduction

The Clean Water Act requires the State to establish a Total Maximum Daily Load (TMDL) for the San Lorenzo River Estuary and Carbonera Creek. A TMDL is required because these waters have been identified as impaired and have been placed on the Federal 303(d) List.

San Lorenzo River Estuary

San Lorenzo River Estuary is on the 303(d) List for non-attainment of pathogen water quality objectives. Based on historic and recent data, pathogen indicator organism (fecal coliform) concentrations exceed *Water Quality Control Plan, Central Coast Region* (Basin Plan) water contact recreational use and shellfish harvesting[1] objectives during both wet and dry seasons. The cause of impairment is sewage spills; storm drain discharges; homeless encampments; illegal recreational vehicle discharges; occasional septic system failures; and farm animals/livestock. Birds, rodents, and wildlife also contribute to impairment.

Carbonera Creek

Carbonera Creek is on the 303 (d) List for non-attainment of EPA pathogen criteria. Based on historic and recent data, the pathogen indicator organism (*E.coli*) exceeds EPA pathogen criteria for water contact recreational use. The cause of impairment is sewage spills; storm drain discharges; homeless encampments; occasional septic system failures; and farm animals/livestock. Birds, rodents, and wildlife also contribute to impairment.

Clean Water Act Section 303(d) requires the State to establish a Total Maximum Daily Load (TMDL) at a level that attains water quality water quality objectives. The State must also incorporate seasonal variations and a margin of safety into the TMDL that takes any lack of knowledge into account concerning the relationship between load limits and water quality.

1.2. Listing Basis

San Lorenzo River Estuary

[1] Staff is proposing to remove the shellfish harvesting beneficial use in the San Lorenzo River Estuary.

The California Regional Water Quality Control Board, Central Coast Region (Water Board) placed San Lorenzo River Estuary pathogens on the 303(d) List of impaired waters in1994. San Lorenzo River Estuary was listed based in several reports indicating high bacteria concentrations. These include *An Evaluation of Wastewater Disposal and Water Quality in the San Lorenzo River Watershed* (Sept 1989, Environmental Health Service, Health Services Agency, County of Santa Cruz). In that report, the sampling location "Rivermouth @ Trestle" was reported to exceed the REC-1 fecal coliform objective from October 1985-September 1988. Another report titled *San Lorenzo River Watershed Management Plan Update, Evaluation of Water Urban Quality, Task 4 Report* (August 2001, Environmental Health Service, Health Services Agency, County of Santa Cruz) indicates the sampling location "Rivermouth @ Trestle" was reported to also exceed the REC-1 fecal coliform objective from October 1990-September 1991 and from October 1992-September 1993. The County's recent data is discussed in Chapter Three.

According to the United States Environmental Protection Agency Protocol for Developing Pathogen TMDLs (EPA Protocol), "the numbers of pathogenic organisms present in polluted waters generally are few and difficult to isolate and identify, as well as highly varied in their characteristic and type. Therefore, scientists and public health officials typically choose to monitor nonpathogenic bacteria that are usually associated with pathogens transmitted by fecal contamination by are more easily sampled and measured. These associated bacteria are called indicator organisms. Indicator organisms are assumed to indicate the potential presence of human pathogenic organisms. When large fecal coliform populations are present in the water, it is assumed that there is a greater likelihood that pathogens are present." The Basin Plan uses fecal coliform concentrations as water quality objectives to represent pathogenic organisms.

Carbonera Creek

The California Regional Water Quality Control Board, Central Coast Region (Water Board) placed San Lorenzo River Estuary pathogens on the 303(d) List of impaired waters in1994. San Lorenzo River Estuary was listed based in several reports indicating high bacteria concentrations. These include *An Evaluation of Wastewater Disposal and Water Quality in the San Lorenzo River Watershed* (Sept 1989, Environmental Health Service, Health Services Agency, County of Santa Cruz). "Carbonera Creek below Scotts Valley" reported exceeding the REC-1 fecal coliform objective form October 1985 – September 1987. The same report indicated the sampling location "Carbonera Creek @ HWY 1" did not exceed the fecal coliform objective during the same time period. .

According to the United States Environmental Protection Agency Protocol for Developing Pathogen TMDLs (EPA Protocol), "the numbers of pathogenic organisms present in polluted waters generally are few and difficult to isolate and identify, as well as highly varied in their characteristic and type. Therefore, scientists and public health officials typically choose to monitor nonpathogenic bacteria that are usually associated with pathogens transmitted by fecal contamination by are more easily sampled and measured. These associated bacteria are called indicator organisms. Indicator organisms

are assumed to indicate the potential presence of human pathogenic organisms. When large fecal coliform populations are present in the water, it is assumed that there is a greater likelihood that pathogens are present." The Basin Plan uses fecal coliform concentrations as water quality objectives to represent pathogenic organisms.

1.3. Beneficial Uses

The Basin Plan contains beneficial uses for San Lorenzo River Estuary. The San Lorenzo River Estuary beneficial uses are shown in Table 1-1.

Table 1. Beneficial Uses for San Lorenzo River Estuary

Beneficial Use	Waterbody Name	
	San Lorenzo River Estuary	Carbonera Creek
Municipal and domestic supply	•	X
Agricultural supply	•	X
Industrial	•	X
Groundwater recharge	•	X
Water contact recreation	X	X
Non-contact water recreation	X	X
Wildlife habitat	X	X
Cold fresh water habitat	X	X
Migration of aquatic organisms	X	X
Spawning, reproduction, and/or early development	X	X
Preservation of biological habitats of special significance	X	•
Rare, threatened, or endangered species	X	•
Estuarine Habitat	X	•
Commercial and sport fishing	X	X
Shellfish Harvesting[1]	X	•

Staff has found no evidence of the shellfish harvesting beneficial use in the San Lorenzo River Estuary. Hydraulic modifications, seasonal lagoon closure to tidal circulation, and lack of evidence of any historical or contemporary shellfish harvesting, have led Water Board staff to propose removing the SHELL beneficial use in San Lorenzo River Estuary. Appendix Five, "Use Attainability Analysis for San Lorenzo River Estuary", provides the basis for staff's proposal.

[1] Staff is proposing to remove the shellfish harvesting beneficial use in the San Lorenzo River Estuary.

1.4. Water Quality Objectives

The Basin Plan contains specific water quality objectives that apply to fecal coliform (Basin Plan, pg. III-10). These objectives are linked to specific beneficial uses and include:

Water Contact Recreation (REC-1)

Fecal coliform concentration, based on a minimum of not less that five samples for any 30-day period, shall not exceed a log mean of 200-per 100 mL, nor shall more than 10% of samples collected during any 30-eay period exceed 400 per 100 mL.[1]

E. coli is another pathogen indicator organism. There are no water quality objectives for *E. coli*. However, the United States Environmental Protection Agency (USEPA) recommends *E. coli* not exceed a log mean of 126 CFU per 100 mL, based on not less that 5 samples equally spaced over a 30-day period. The USEPA also recommends that not more than 10% of samples collected during a 30-day period exceed 235 per 100 mL.

Non-Contact Water Recreation (REC-2):

Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 2000 per 100 mL, nor shall more thatn10% of samples collected during any 30-day period exceed 4000 per 100 mL.

Staff is proposing to remove the shellfish harvesting beneficial use for San Lorenzo River Estuary.

Santa Cruz County Environmental Health Services has performed parallel testing for *E.coli* and fecal coliform. Testing results have shown that fecal coliform levels and *E.coli* concentrations are equivalent at sample points in the San Lorenzo Watershed (personal communication with John Ricker, Santa Cruz County Environmental Health Services, December 29, 2005).

1.5. Waste Discharge Prohibition

The *Water Quality Control Plan, Central Coast Region* (Basin Plan) contains the following discharge prohibition on Chapter Five, Section IV.B.

[1] Throughout this document, fecal coliform units are expressed as colony forming unit (CFU), organisms, count (#/100mL or CFU/100 mL) and most probable number (MPN). All unit expressions are considered equivalent fecal coliform bacteria concentration measures (Reference: Protocol for Developing Pathogen TMDLs).

> "Waste discharges to the following inland waters are prohibited:…All surface waters within the San Lorenzo River, Aptos-Soquel, and San Antonio Creek Subbasins and all water contact recreation areas except where benefits can be realized from direct discharge of reclaimed water."

The above prohibition is clear. No waste discharges are allowed in San Lorenzo River subbasins. San Lorenzo River Estuary and Carbonera Creek are both within the San Lorenzo River subbasins.

2. WATERSHED DESCRIPTION

2.1. Location, Climate, and Hydrology

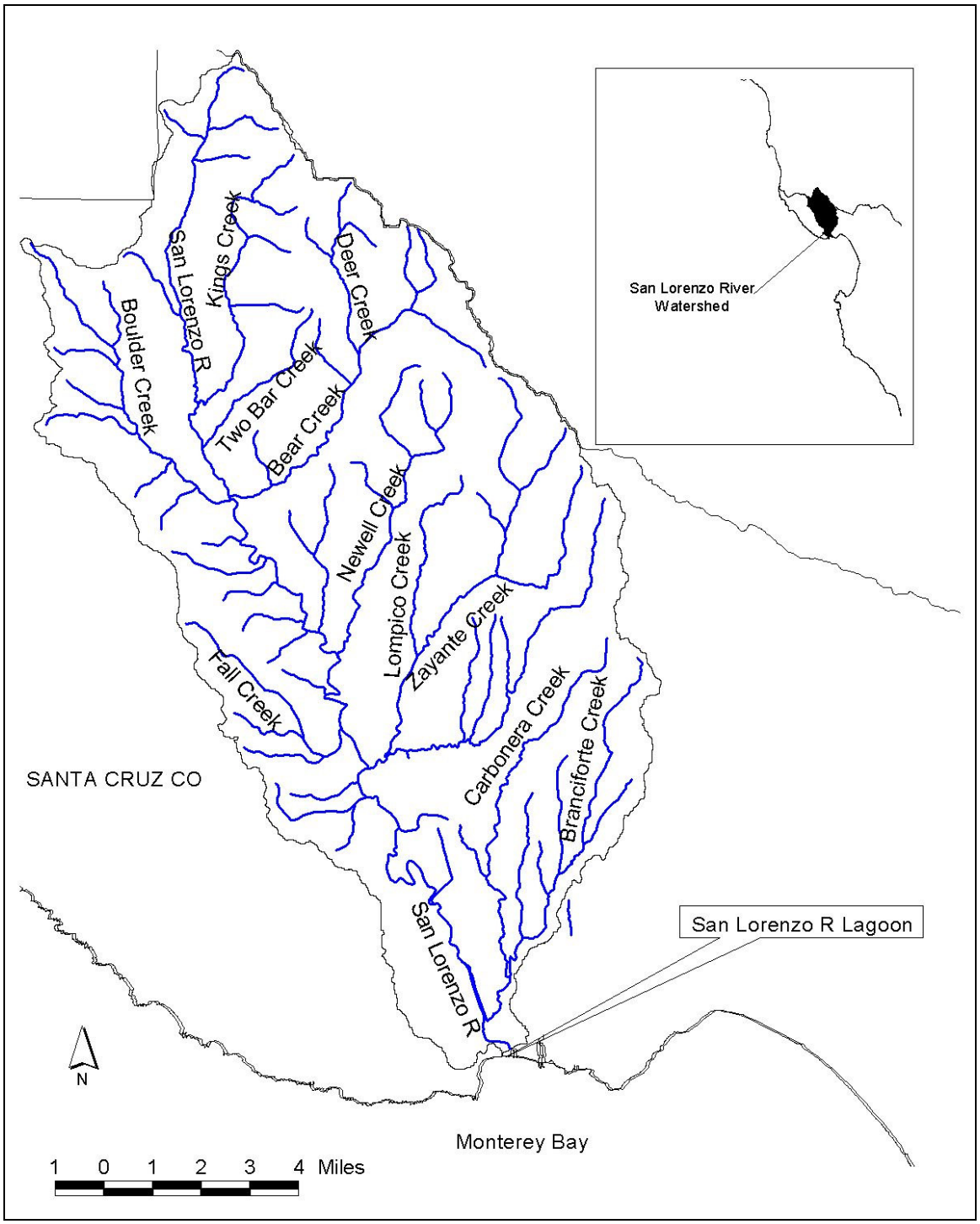
The San Lorenzo River flows from the Santa Cruz Mountains toward the City of Santa Cruz. San Lorenzo River Estuary is located within the City of Santa Cruz. According to the U.S. Census Bureau, the City population in the year 2000 was approximately 54, 600 persons.

The Estuary is a receiving water for approximately 87,823 acres and drains into northern Monterey Bay. Land uses include forestlands, open space, and urban uses. Major tributaries of San Lorenzo River include Branciforte Creek, Zayante Creek, Newell Creek, Love Creek, Bear Creek, Kings Creek, Boulder Creek, and Shingle Mill Creek.

Carbonera Creek flows from the City of Scotts Valley in northern Santa Cruz County and through the County of Santa Cruz. Carbonera Creek ends at the confluence with Branciforte Creek in the City of Santa Cruz. The City of Santa Cruz is approximately six miles downstream of the City of Scotts Valley. According to the Scotts Valley Chamber of Commerce, the City's population in 2000 was approximately 11,400 persons.

San Lorenzo River Estuary and Carbonera Creek

The figure below shows the location of San Lorenzo River Estuary and Carbonera Creek.. Staff determined the San Lorenzo River Estuary boundary by analyzing conductivity data. Staff concluded the Soquel Avenue Bridge is the approximate inland Estuary boundary. However, estuary water levels can rise back to Water Street when a sand bar closes the Estuary outlet to the Ocean. Staff analysis of conductivity data is shown in Appendix Four.



Larry, I need a figure that has governmental jurisdictions. The reader should understand where the City of Santa Cruz, City of Scotts Valley, and Santa Cruz County boundaries are. State Parks, Count Parks and other "parks" such as the Pogonip Open Space are also useful

Change "Lagoon to Estuary"

Figure 1. Location of San Lorenzo River Estuary and Carbonera Creek

The following provides a general description of the climate. "The Watershed's Mediterranean climate is moderated by its close proximity to the Pacific Ocean. Summers are warm and dry, cooled at times by morning fog at lower elevations. The winters are cool and wet. Average annual rainfall is about 47 inches, ranging from about 30 inches in Santa Cruz to 60 inches above Boulder Creek. Eighty-two percent of this rainfall occurs in the four-month period from December through April" (*The San Lorenzo River Watershed Management Plan*, December 1979 (Watershed Management Plan)).

The average total precipitation is for the City of Santa Cruz is 30.6 inches. The figure below shows average monthly precipitation totals from 1948 to 2005.

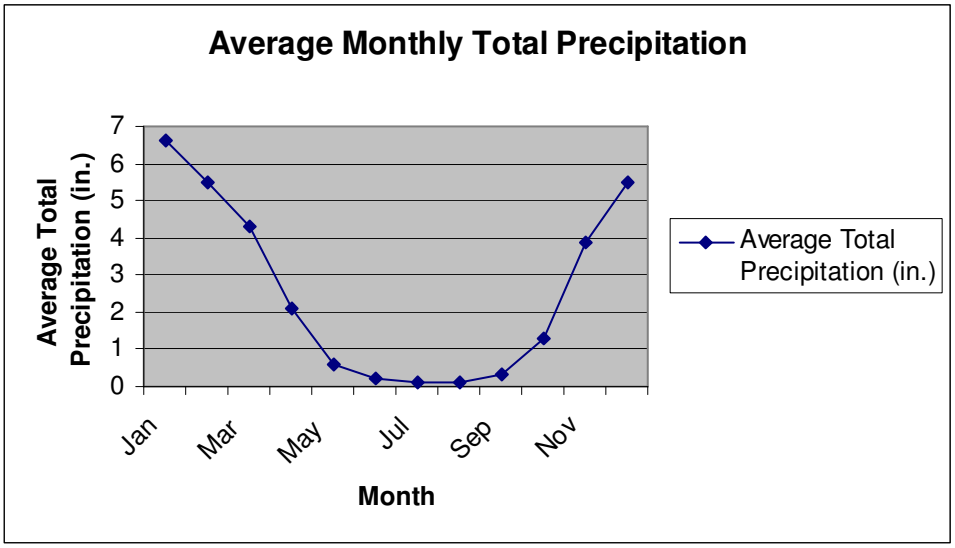


Figure 2. City of Santa Cruz Average Monthly Precipitation (Averages taken form 1948 through 2005)

The Watershed Management Plan also provides San Lorenzo River flow information. The Watershed Management Plan states that normal (median monthly) flows of the main river drop from a high of 170 cubic feet per second (cfs) in February to a low of 17 cfs in September.

2.2. Land Use

The figure below show land uses in the San Lorenzo River watershed. GIS land use data used was obtained from the Multi-Resolution Land Characterization (MRLC) database and subsequently grouped into land use categories. The MRLC is a consortium of federal

government agencies acting together to acquire satellite imagery for various environmental monitoring programs. One program that resulted from the MRLC effort is the National Land Cover Data program, which used images acquired from LANDSAT's Thematic Mapper sensor, as well as ancillary data sources, to produce a national land cover data set. The MRLC land use data used for this load analysis is representative of years from approximately 1988 to 1994.

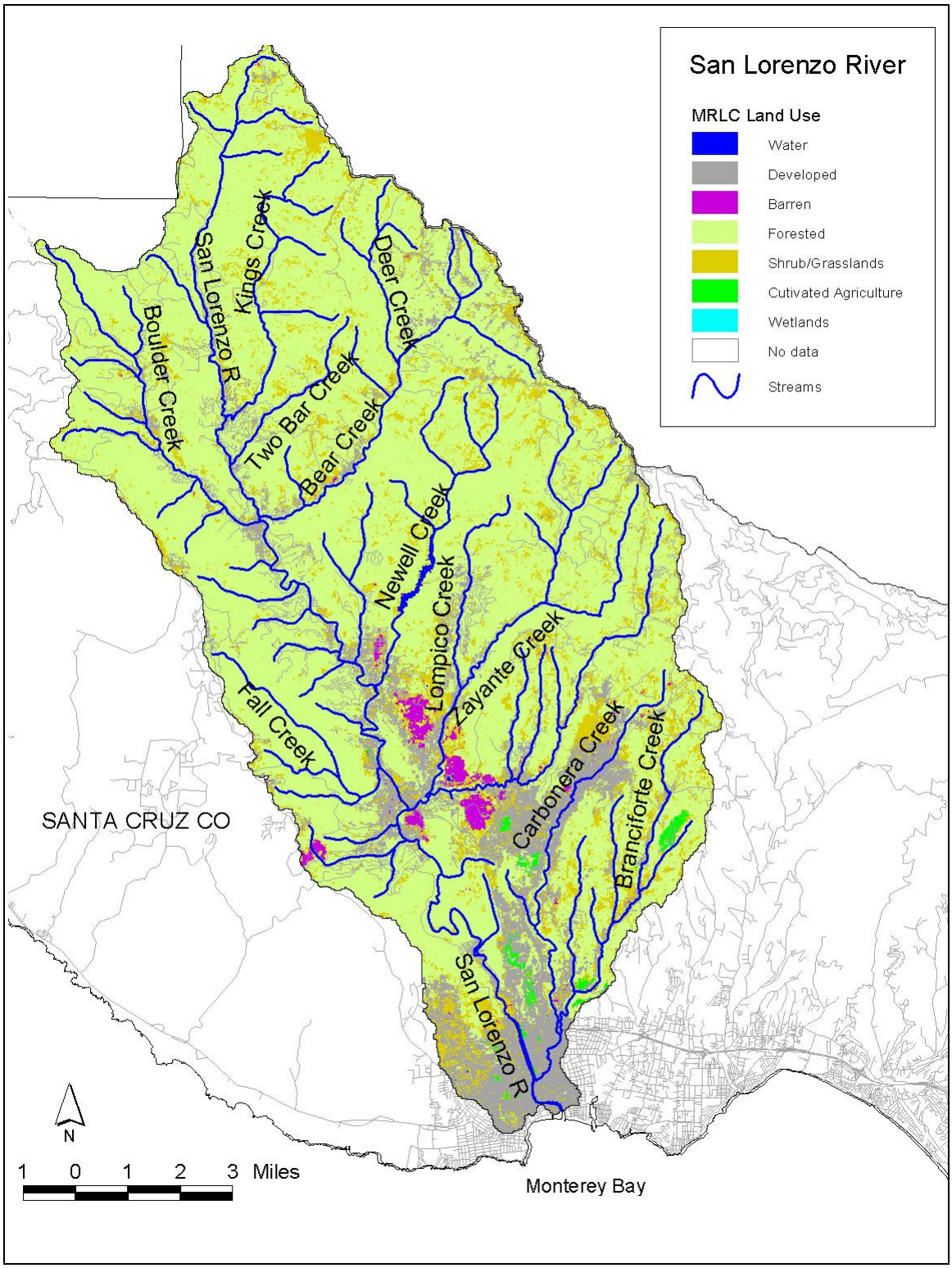


Figure 3. San Lorenzo River Land Uses (Including Carbonera Creek)

The figure below shows percent land use acreage for the San Lorenzo River watershed

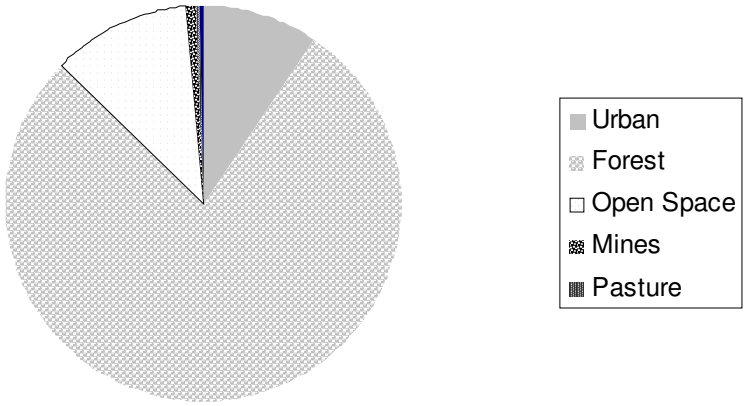


Figure 4. Percent Land Use in the San Lorenzo River Watershed

The San Lorenzo River Watershed is approximately 170 square miles in size. The largest land use in this watershed is forestland (78%). We consider forestlands to be comprised of deciduous forest, evergreen forest, and mixed forest. The second and third largest land uses are open space (11%) (comprised of deciduous shrub land and grassland/herbaceous lands) and urban lands (10%) (comprised of low intensity residential, high intensity residential, and high intensity commercial, industrial, and transportation lands as well as urban parks), respectively. Mines comprise of approximately one percent of the watershed. (The mines sand and gravel mines.) Pasture is only about 0.1% of the watershed area.

The figure below shows percent land use acreage for the San Lorenzo River Estuary subwatershed.

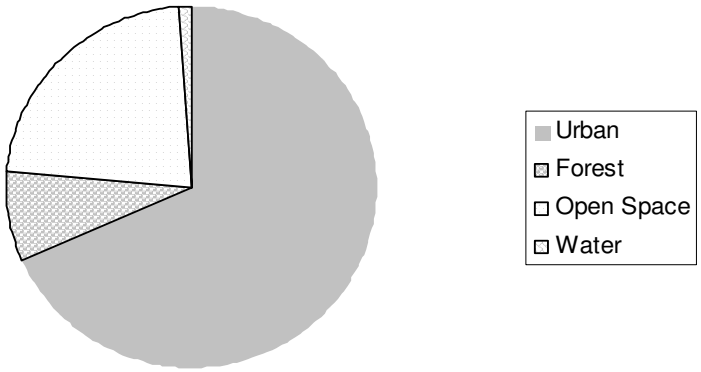


Figure 5. Percent Land Use for the San Lorenzo River Estuary Subwatershed

The San Lorenzo River Estuary subwatershed is approximately three square miles. The largest land use is urban use (68%). The second and third largest land uses are open space(23%) and forestlands (8%), respectively. Surface waters occupy one percent of the subwatershed. Pathogen contributions commonly occur from urban land use.

The figure below shows percent land use acreage for the Carbonera Creek watershed

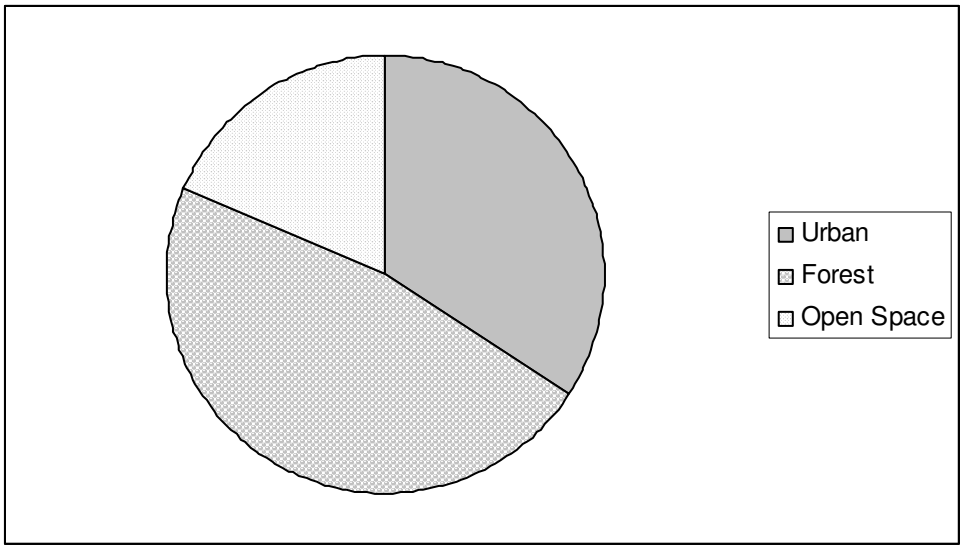


Figure 6. Percent Land Use for Carbonera Creek Watershed

This figure shows the largest land use is within the approximately seven square mile watershed is forestland (47%). The second and third largest land uses are urban uses (34%) and open space 19%), respectively. Pathogen contributions commonly occur from urban land use, but homeless encampments have existed in forestlands.

3. DATA ANALYSIS

3.1. Water Quality Data

This chapter discusses water quality data used to develop this Total Maximum Daily Load, the results of water quality analysis, and discusses impacted areas.

San Lorenzo River Estuary

This report relies on upon water quality sampling performed by the County of Santa Cruz Environmental Health Services. Recent Santa Cruz County fecal coliform sampling activities for San Lorenzo River Estuary are shown in the Table below.

Table 2. Santa Cruz County Environmental Health Services Fecal Coliform Sampling Activity Since January 1, 2000

Station #	Station	Number of Samples	Frequency	Period of Record[1]
SCC #1	San Lorenzo River Lagoon @ Trestle	286	Weekly	01/04/2000-02/28/2005
SCC #2	San Lorenzo River Lagoon @ Broadway/Laurel Bridge	262	Weekly	01/04/2000-02/28/2005
SCC #3	San Lorenzo River @ Soquel Avenue Bridge	36	Irregular	11/24/1986-02/19/1997
SCC #4	San Lorenzo River @ Sycamore Grove	315	Weekly	01/04/2000 – 02/21/2005
SCC #5	Branciforte Creek @ San Lorenzo River	29	Irregular	04/11/ 1995 – 02/26/2002
SCC #6	Branciforte Creek @ Carbonera Creek	7	Irregular	09/20/1995 – 01/24/2002
SCC #7	Branciforte Creek @ Isbel Drive	49	Monthly	02/09/2000 - 06/15/2005
SCC #8	Carbonera Creek @ Branciforte Creek	26	Irregular	04/11/2000-06/14/2005

This table shows that the County sampled two San Lorenzo River Estuary stations (San Lorenzo River Lagoon @ Trestle and San Lorenzo River Lagoon @ Broadway/Laurel Bridge) on a weekly basis. The other Estuary station (San Lorenzo River @ Soquel Avenue Bridge) is sampled irregularly and has not been sampled since 1997. One station

[1] Staff also reviewed water quality data after the period of record. Staff received additional data through January 2006. This data is presented in Appendix One. This report provides changes within footnotes to this chapter where the more recent data changes to the body of this report .

(San Lorenzo River @ Sycamore Grove) provides upstream San Lorenzo River information. The remaining sites provide data upstream data for Branciforte Creek and Carbonera Creek.

The figure below shows the San Lorenzo River Estuary monitoring stations and upstream stations shown in Table Two. The figure also shows two numbers. The first number is the percent exceedance and the second is the number of samples.

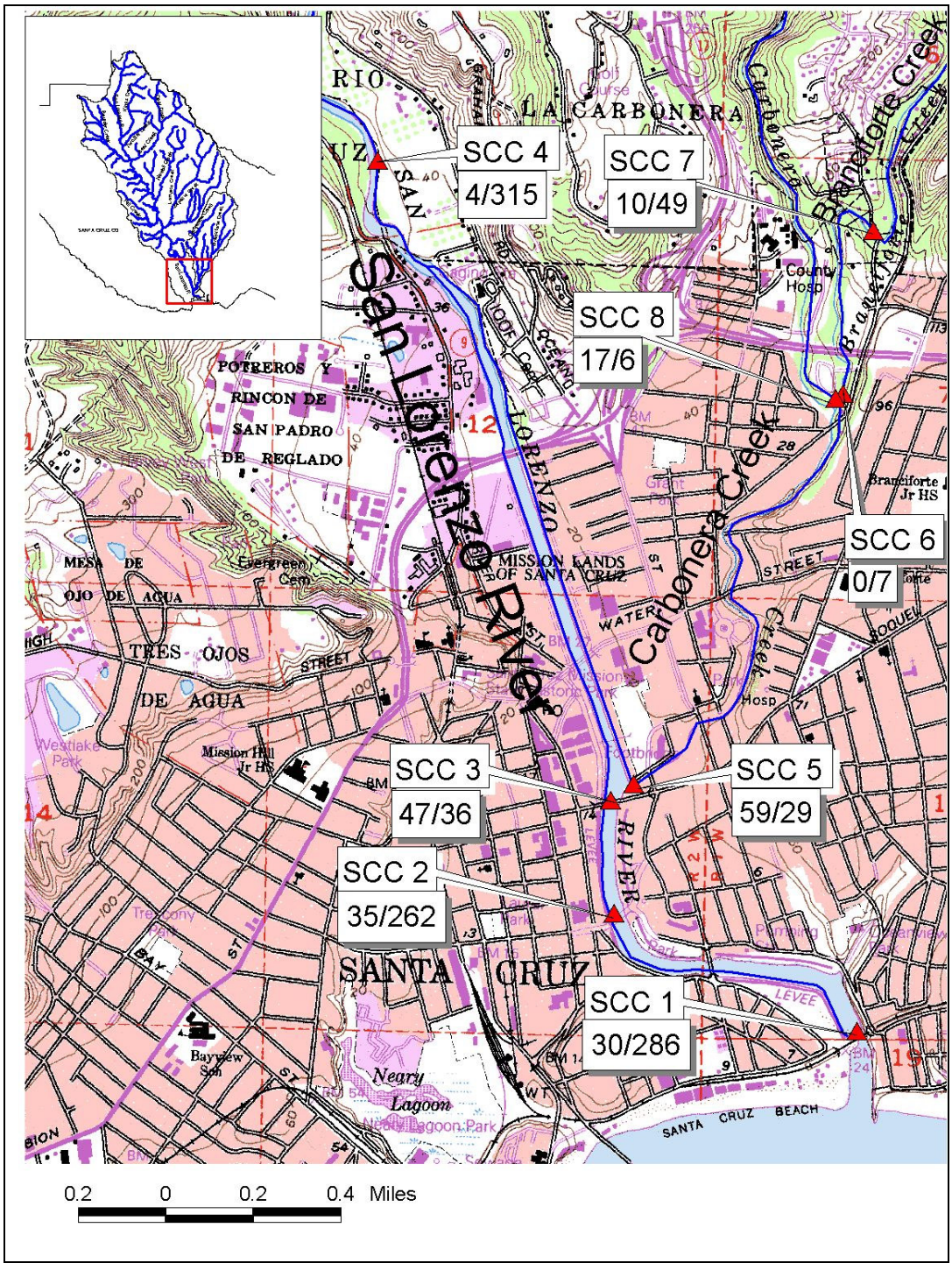


Figure 7. San Lorenzo River Estuary Sampling Stations, Percent Exceedance, and Number of Samples

(Larry, please rearrange "Carbonera Creek" and "Branciforte Creek" (Branciforte Creek is the name of the lower reach.)

Carbonera Creek

This report relies also on upon water quality sampling performed by the City of Scotts Valley and Santa Cruz County. Recent City of Scotts Valley *Escherchia coli* (*E.coli*) and Santa Cruz County fecal coliform sampling activities are shown in the Table below.

Table 3. City of Scotts Valley and Santa Cruz County Sampling Activity Since January 1, 2000

Station #	Station	Number of Samples	Frequency	Period of Record
SV #1	Camp Evers Cr @ Cold Stream Way	6	Weekly	01/06/2005-02/172005
SV #2	Camp Evers Cr @ Whispering Pines	6	Weekly	01/06/2005-02/1720/05
SV #3	Camp Evers Cr @ Carbonera Cr	6	Weekly	01/06/2005-02/17/2005
SV #4	Carbonera Cr @ Disc Drive	6	Weekly	01/06/2005-02/17/2005
SV #5	Carbonera Cr above Camp Evers	6	Weekly	01/06/2005-02/17/2005
SV #6	Carbonera Cr @ Hwy 17	6	Weekly	01/06/2005-02/17/2005
SCC #8 [1]	Carbonera Creek @ Branciforte Creek	6	Irregular	04/11/2000-06/14/2005

[1] County of Santa Cruz Environmental Health Services sampled this station.

This table shows that the City of Scotts Valley sampled six Carbonera Creek stations on a weekly basis for one and one-half months during the winter of the year 2005. The purpose of this sampling was to determine if pathogen impairment occurs. The winter season was initially sampled because the winter season is typically the season that shows impairment.

The figure below shows the Carbonera Creek monitoring stations (This Figure does not show the lowest Carbonera Creek Station (SCC #8). This station is shown in the figure above.) The figure also shows two numbers. The first number is the percent exceedance and the second is the number of samples.

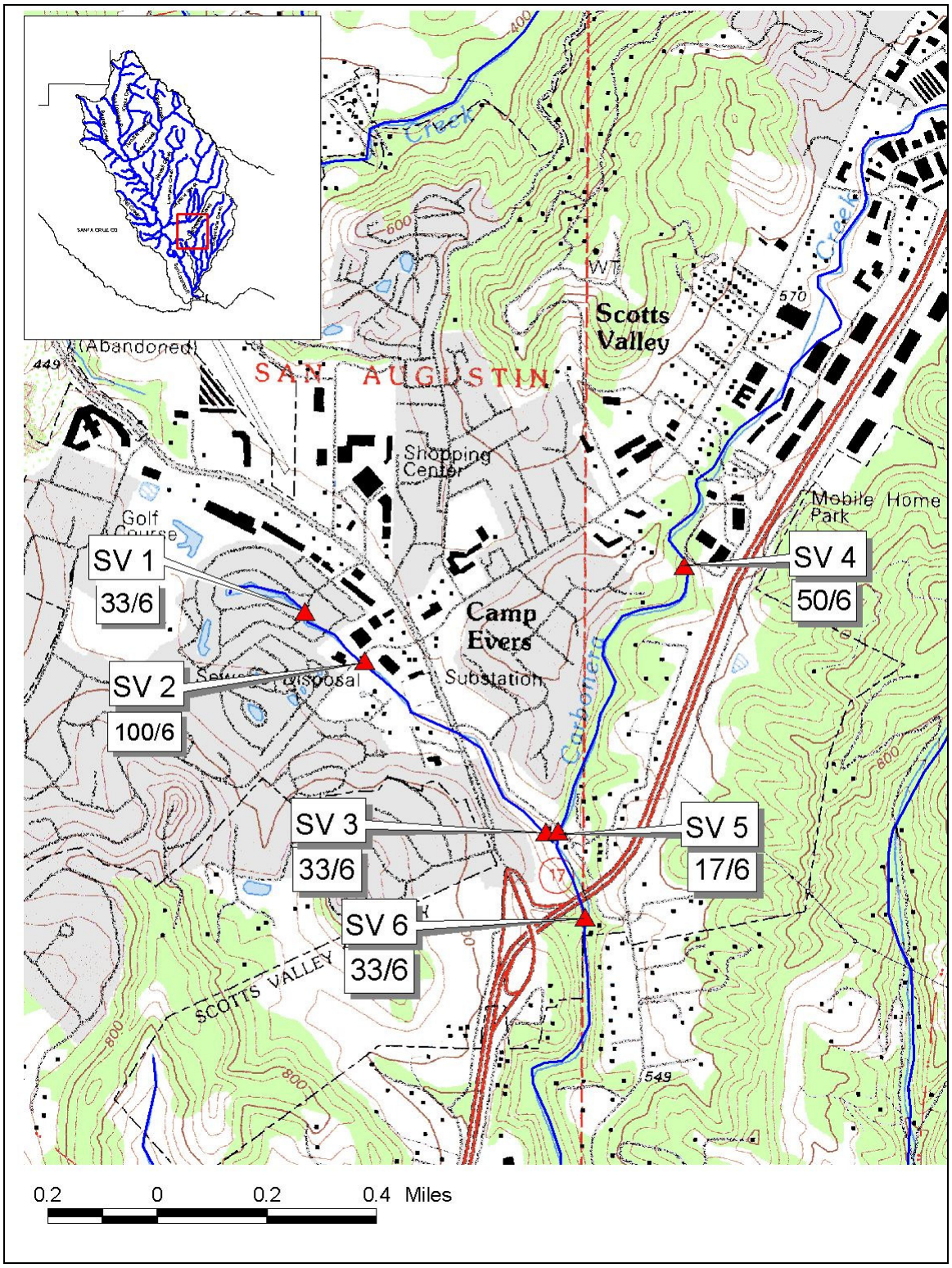


Figure 8. Carbonera Creek Sampling Stations, Percent Exceedance, and Number of Samples

3.2. Data Analysis

Staff analyzed Santa Cruz County Environmental Health and the City of Scotts Valley water quality sampling results using a program developed by Tetra Tech, the United States Environmental Protection Agency's contractor. The program is titled "Fecal Coliform Investigation and Analysis Spreadsheet" (FECIA). FECIA is a fully automated spreadsheet designed to assist in characterization and quantification of pathogen indicator instream water quality objective exceedances. Observed data are compared against specified objectives to determine the magnitude and nature of exceedances.

The FECIA program generated the data analysis figures and tables located in Appendix Two of this document. Figures are generated for each sampling station. Each figure analyzes the data shown in Section 3.1 of this report. The figure displays either the REC-1 geometric mean water quality objective or the REC-1 maximum water quality objective. The maximum water quality objective (400 MPN) is used when the County takes less than five samples in a 30-day period[1]. Concentration ranges, the range of concentrations within the 25^{th} -75^{th} percentile range, the mean concentration, and the median concentration are shown.

The FECIA program also generates tables that summarize data on a monthly basis. Tables are generated for each sampling station. Each table shows the mean, median, minimum, maximum, the 25^{th} percent deviation, the 75^{th} percent deviation, the number of water quality objective exceedances, the sample count, and the percent sample exceedance.

Staff found this program useful because for each station sampled, the program automatically calculates statistical information such as mean concentrations, median concentrations, and percent objective exceedance.

3.3. Data Analysis Summary

San Lorenzo River Estuary

This section summarizes FECIA data analysis contained in the Appendix Two. The results are shown in the table below.

[1] *E.coli* data is compared to EPA criteria.

Table 4. San Lorenzo River Estuary Percent Violations of Water Quality Objectives

Station	Station Number	Geometric Mean Water Quality Objective		Maximum Water Quality Objective	
		% Violations	Number of Sample Sets	% Violations	Number of Samples
San Lorenzo River Lagoon @ Trestle	SCC #1	52%	270	30%	286
San Lorenzo River Lagoon @ Broadway/Laurel Bridge	SCC #2	61%	226	35%	262
San Lorenzo River @ Soquel Avenue Bridge	SCC #3	(1)	(1)	47%	36
San Lorenzo River @ Sycamore Grove	SCC #4	2%	310	4%	315
Branciforte Creek @ San Lorenzo River	SCC #5	(1)	(1)	59%	29
Branciforte Creek @ Carbonera Creek	SCC #6	(1)	(1)	0%	7
Branciforte Creek @ Isbel Drive	SCC #7	(1)	(1)	10%	49

(1) Insufficient data to calculate geometric mean

Figure Seven above also shows the percent violation of the maximum water quality objective and the number of samples used to determine the percent violation applicable for the maximum water quality objective. The first number in this figure is the % violations and the second number represents the number of samples used to determine the % violations. Figure Seven is useful because it shows the water quality analysis results in a special manner.

Carbonera Creek

This section summarizes FECIA data analysis contained in the Appendix Two. The results are shown in the table below.

Table 5. Carbonera Creek Percent Violations of Water Quality Criteria

Station	Station Number	Geometric Mean Water Quality Objective		Maximum Water Quality Objective	
		% Violations	Number of Sample Sets	% Violations	Number of Samples
Carbonera Creek @ Branciforte Creek	SCC #8	(1)	(1)	17%	6
Carbonera Creek @ Hwy 17	SV #6	(1)	(1)	33%	6

Carbonera Creek above Camp Evers	SV #5	(1)	(1)	17%	6
Carbonera Creek @ Disc Drive	SV #4	(1)	(1)	50%	6
Camp Evers Creek @ Carbonera Creek	SV #3	(1)	(1)	33%	6
Camp Evers Creek @ Whispering Pines	SV #2	(1)	(1)	100%	6
Camp Evers Creek @ Cold Stream Way	SV#1	(1)	(1)	33%	6

(1) Insufficient data to calculate geometric mean

Figure Eight above also shows the percent violation of the EPA maximum water quality criteria and the number of samples used to determine the percent violation applicable for the maximum water quality objective. The first number in this figure is the % violations and the second number represents the number of samples used to determine the % violations. Figure Eight is useful because it shows the water quality analysis results in a special manner.

3.4. Impacted Area

This section identifies impacted areas. The areas are identified using the figures shown in Section 3.1 of this report.

San Lorenzo River Estuary

San Lorenzo River Estuary Reach

San Lorenzo River Estuary is impaired by fecal coliform downstream of the confluence with Branciforte Creek. Fecal coliform concentrations at the Soquel Avenue Bridge (just below the confluence with Branciforte Creek) exhibit the highest fecal coliform maximum objective exceedance in the Estuary. Unfortunately, there is no recent data for this station. The most recent year of sampling occurred in 1997.

Branciforte Creek (San Lorenzo River to Carbonera Creek Reach)

Branciforte Creek is also impaired by fecal coliform. The Branciforte Creek at San Lorenzo River station exceeded the fecal coliform maximum objective 59% of the time from 1995 to 2002. One recent sample was taken on September 26, 2005. This sample was below the water quality objective.[1]

[1] The overall percent exceedance of this station including the September 26, 2005 sample is 57%.

Branciforte Creek (Carbonera Creek to Headwaters Reach)

Branciforte Creek appears to have better water quality. However, additional sampling at the Branciforte Creek at the Carbonera Creek station is necessary to determine if this reach meets the water quality objectives.

San Lorenzo River (Branciforte Reach to Sycamore Grove)

San Lorenzo River is not impaired upstream of the confluence with the Branciforte Creek as exhibited by the San Lorenzo River at Sycamore Grove station data. (The fecal coliform geometric mean objective at is Sycamore Grove station is exceeded only 2% of the time and the maximum objective is exceeded only 4% of the time.)[1]

Carbonera Creek

E.coli impaired Carbonera Creek during January and February 2005 within the City of Scotts Valley. Three stations were sampled on Carbonera Creek. The *E. coli* concentrations exceeded the EPA criteria within 17-50 %. Three stations were sampled on Camp Evers Creek. The *E. coli* concentrations exceeded the EPA criteria within 33-100 %.

The Carbonera Creek water quality sampling station upstream of Branciforte Creek has insufficient data to determine impairment conditions.

All Carbonera Creek stations have insufficient data to determine if Carbonera Creek is impaired. The TMDL proposes additional Carbonera Creek monitoring and provides implementation measures in the event this water is impaired.

[1] The overall percent exceedance of this station through January 2006 sample is 5%.

4. SOURCE ANALYSIS

For San Lorenzo River Estuary, this chapter relies upon a report prepared by the County of Santa Cruz, Environmental Health Service, Water Resources Program. The report is titled *Draft Assessment of Sources of Bacterial Contamination at Santa Cruz County Beaches* prepared in October, 2005 (Proposition 13 Report). With the exception of information presented regarding Carbonera Creek, all information used within this report is from the Proposition 13 report unless otherwise cited.

Carbonera Creek has not yet been identified as impaired. However, in the event further water quality monitoring indicates Carbonera Creek is impaired, this report identifies likely sources. Staff identified potential sources based on existing water quality data; wastewater spill data; discussions with City of Scotts Valley staff; staff assumptions based on the Prop 13 Report; and ribotyping results for other water bodies within the Central Coast Region.

4.1. Water Quality Investigation Results

This chapter identifies sources by performing two investigation types. One method is microbial source analysis and the other method is fecal coliform sampling.

Microbial Source Analysis Results

Genetic ribotyping is a microbiological source tracking method that differentiates human *Escherichia coli (E.coli)* from other sources of *E.coli*. Dr. Mansour Samadpour of the University of Washington Public Health Department has worked with over 100,000 *E.coli* samples and has developed a genetic fingerprint that is specific to *E.coli* sources. He uses ribotype matching as a method of analyzing band patterns of RNA extracted from *E.coli* isolates. He collects samples from contaminated stream sites and matches them to band patterns extracted from known sources of *E.coli*. Numerous agencies in California have used Dr. Samadpour's method with a great success, including a study of Morro Bay, California.

Although this report presents various sources in "percent contribution" values, we consider Dr. Samadpour's results as estimates of source contributions. Dr. Samadpour's results are not absolute values, but his results provide valuable information in terms of relative contributions among various sources.

Santa Cruz County personnel collected samples from one station in San Lorenzo River Estuary mouth and from one station upstream of the Estuary at Sycamore Grove. A map showing ribotyping collection sites is shown below.

[Larry please provide map showing ribotyping sampling sites.]

Ribotyping samples were collected for a time period spanning more than one and one-half years. However, most samples were taken during wet weather conditions. We are presenting all the data for wet and dry periods because it provides more sampling results.

The ribotyping analysis revealed the following results.

Table 6. Percent Source Contributions from Two Sites from January 2002-September 2004

	Percent Source Contribution	
Sites	**San Lorenzo River Estuary at Trestle**	**San Lorenzo River at Sycamore Grove**
Dates	**1/28/2002 - 9/21/2004**	**1/28/2002 - 8/4/2004**
Source		
Bird	45 %	36 %
Cat	0 %	1 %
Cow	1 %	4 %
Dog	6 %	6 %
Horse	1 %	1 %
Human	20 %	17 %
Marine Mammal	0 %	0 %
Rodent	7 %	10 %
Unknown	14 %	14 %
Wildlife	6 %	10 %
Total Water Samples	71	41
Total Isolate Samples	282	156

The table above shows that birds and humans are the two largest sources at both sites. Birds contribute 45 percent of *E.Coli* at the Trestle Station and 36 percent at the Sycamore Grove Station. Humans contribute 20 percent of *E.Coli* at the Trestle Station and 17 percent at the Sycamore Grove Station. The unknown component is 14 percent at both stations. Rodents contribute 7 percent of *E.Coli* at the Trestle Station and 10 percent at the Sycamore Grove station. The remaining sources at the Trestle station account for 14 percent of the *E. coli* contribution and 23 percent of the contribution at the Sycamore Grove station.

The table below displays seasonal bacteria contribution information.

Table 7. Variation of Bacteria Sources During Wet and Dry Seasons (January 2002 - September 2004)

	San Lorenzo River at Mouth		San Lorenzo River at Sycamore Grove	
Source/Percent Occurrence	**Wet[1]**	**Dry[2]**	**Wet[1]**	**Dry[2]**
Bird	37%	52%	25%	49%
Cat	0%	0%	1%	1%
Cow	1%	2%	5%	4%
Dog	6%	7%	6%	7%
Horse	1%	1%	0%	3%
Human	25%	15%	20%	14%
Rodent	6%	7%	11%	9%
Unknown	18%	10%	20%	7%
Wildlife	6%	5%	16%	4%
No. of Isolates	127	155	87	69
No. of Sample Dates	8	15	7	8

[1]Wet =Samples taken during a time when more than 72 hours occurred without rain
[2]Dry= Samples taken during a time when rain occurred within the previous 72 hours

The table also indicates that for San Lorenzo River mouth, birds contribute 15 percent more during dry periods and humans contribute ten percent more during wet periods. For San Lorenzo River at Sycamore Grove, birds contribute 24 percent more during dry periods and humans contribute 6 percent more during wet periods.

WASTE DISCHARGES SUBJECT TO REGULATION BY THE WATER BOARD

This section discusses sources subject to discharge regulation of the Water Board. This section breaks out the mechanism by which various sources provided in Table Six reach San Lorenzo River Estuary and Carbonera Creek.

Sewage Spills and Leaks from Municipal System

Sewage spills and leaks are expected to contain mostly human waste. Other sources such as rodent waste or pet waste may exist in sewage spills to a minor extent.

The Water Board has issued a National Pollutant Discharge Elimination System (NPDES) permit to the City of Santa Cruz. The City of Santa Cruz NPDES permit addresses the collection system, wastewater treatment plant, and disposal system. The wastewater treatment plant discharges treated wastewater to the Pacific Ocean. However, collection system spills and leaks may discharge to the Estuary.

The Water Board has issued a National Pollutant Discharge Elimination System (NPDES) permit to the City of Scotts Valley. The City of Scotts Valley NPDES permit address the wastewater collection, treatment, transport and disposal system. The City

operates a wastewater treatment plant located within the City of Scotts Valley. The City's wastewater is also discharged to the Pacific Ocean at the City of Santa Cruz outfall. Accidental spills from the wastewater treatment plant and collection system may discharge to Carbonera Creek and eventually the San Lorenzo River Estuary.

The Santa Cruz County Sanitation District WDR addresses the County collection system. Wastes generated within the Sanitation District are collected and treated at the City of Santa Cruz wastewater treatment plant. The Sanitation District sewer main lies below the San Lorenzo River bed. It is located at the Broadway Street Bridge.

Sewage can reach the Estuary and Carbonera Creek from sewer line overflows or leaks. Sewage spills can occur when roots, grease buildup, or other causes block sewer lines. Leaks can also occur from cracked lines or lines with poor connections. When sewer lines are blocked or leaking, sewage may run onto the street, into gutters, and into storm drains.

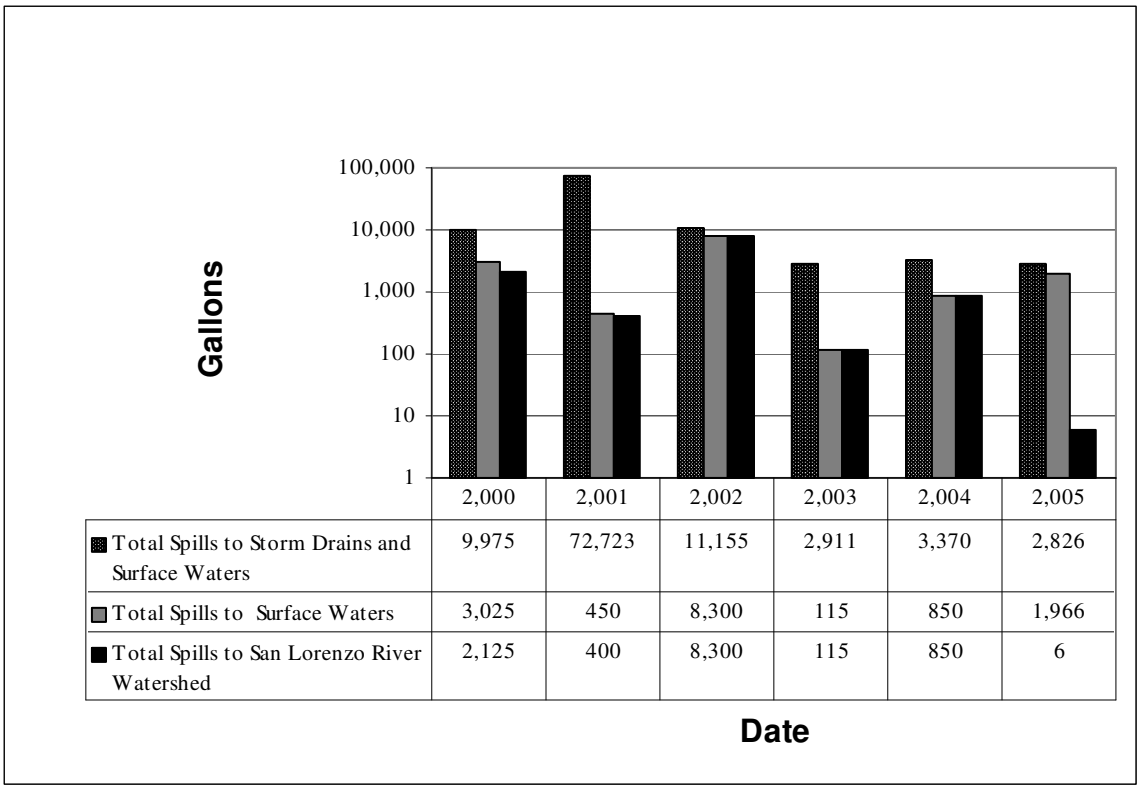
Sewer leaks can also occur in small volumes or below the ground surface. These types of leaks often continue unnoticed.

City of Santa Cruz Municipal Collection System

The City of Santa Cruz has discovered cracks, breaks, and misalignments in sewer lines. Some cross-connections between sewers and storm drains were found and corrected. During the wet season, these situations can contribute to sewer system overflow by rainfall and groundwater infiltration. Conversely, sewage exfiltration potential exists in dry seasons.

Spills have occurred from the City's collection system. The causes of the spills are: 1) sewer main/lift station overflows; 2) sewer line blockages; 3) rainfall inundation resulting in sewage overflows; and 4) human mistakes.

The figure below shows three spill quantities from the City's collection system from January 1, 2000 –November 4, 2005. The largest quantity represents the total spills that result from the City of Santa Cruz collection system. The entire volume of spills does not reach surface waters. The second largest quantity represents spills that reach storm drains and all surface waters (such as Neary's lagoon and Monterey Bay in addition to San Lorenzo watershed waters). The smallest quantity represents collection system spills that reach San Lorenzo River watershed waters only.



	2,000	2,001	2,002	2,003	2,004	2,005
Total Spills to Storm Drains and Surface Waters	9,975	72,723	11,155	2,911	3,370	2,826
Total Spills to Surface Waters	3,025	450	8,300	115	850	1,966
Total Spills to San Lorenzo River Watershed	2,125	400	8,300	115	850	6

Table 8. Spill Volumes Within the City of Santa Cruz1[1]

The chart shows total spill volumes ranged from 72, 723 gallons to 2,826 gallons. Not all of this wastewater reached stormdrains or surface waters.

The chart also shows the total known spill volume reaching all surface waters within the City's jurisdiction (which include the ocean and Neary's Lagoon) and spill volumes that reached only the San Lorenzo River watershed. These spill volumes ranged from 8,300 gallons to 115 gallons.

The chart also shows the total spill volume reaching the San Lorenzo River watershed. These spill volumes ranged from 8,300 gallons to six gallons.

The City of Santa Cruz implements a spill management program to minimize the effects of spills upon surface waters. When spills occur, the City determines if the spills have entered storm drains. If the spill enters the storm drain, the City determines where the spill has migrated and "traps" the spill. The City extracts the spills from the storm drains and hauls the sewage to the wastewater treatment plant. Starting in 2003, the City implemented improved spill management activities that dramatically reduced sewage spill volumes.

[1] Year 2005 data represents January 1, 2005 through November 4, 2005.

Since 1997, the City has replaced or rehabilitated most of the sewer lines in the vicinity of Market Street, River Street, Water Street, Lower Ocean Street, and Beach Flats areas. Additional rehabilitation is scheduled for the lower east side area and Water Street.

The City still needs to assess sewer conditions upstream of Water Street and make necessary repairs. The City should budget future sewer assessment and line maintenance work in this area in future budgets. The City should initially prioritize efforts to focus assessment and repairs to sewers within 100 feet of San Lorenzo River, Branciforte Creek, and Carbonera Creek. The City should then focus efforts on the remaining sewers located within these watersheds.

Scotts Valley Wastewater Treatment Plant and Effluent Pipeline

The City of Scotts Valley operates at secondary wastewater treatment system. This system is located at 700 Lundy Lane in Scotts Valley. Treated wastewater is discharged to the Pacific Ocean through the City of Santa Cruz's outfall.

The treatment plant has experienced spills in the past. However most of these spills were secondarily treated effluent. In the last five years, only two spills of sewage drained to surface waters. One spill on May 17, 2001 to Camp Evers Creek was approximately 50 gallons. This spill occurred because operator error. The second spill on February 25, 2002 resulted in an approximately 312,000-gallon spill to Camp Evers Creek. This spill occurred due to a pump malfunction at the treatment plant.

To prevent these problems from reoccurring the City has implemented improved management of the plant. The City installed an improved pager system to ensure operators are always summoned to address such failures.

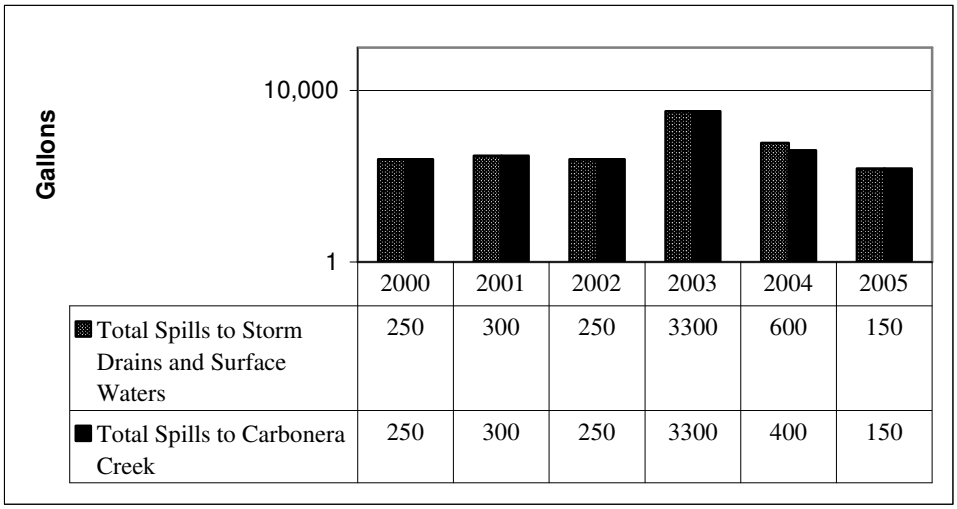
These spills do not represent a chronic problem requiring special action. Rather, they were anomalous events and the Discharger took steps to minimize the likelihood of future occurrences. No such spills have occurred since.

Sewage Sills and Leaks from Municipal Collection System

The City of Scotts Valley has a relatively new collection system. The collection system was installed during the 1960s and consequently may not have the same types of problems older collection systems have.

The City of Scotts Valley performed a video analysis of the entire collection system in 1999. The City repaired every separated collection system joint, sagged pipe, or damaged pipe (reference: phone conversation with Scott Hamby, City of Scotts Valley Wastewater and Environmental Program Manager, Jan 30, 2006).

The figure below shows known spill volume information within the City of Scotts Valley for the year 2000 through 2005. The figure provides information regarding several types of spills. One item the figure displays is the total spills to storm drains and Scotts Valley surface waters. The causes of the total known spill volume are: 1) sewer main/lift station overflows; 2) sewer line blockages; and 3) one broken sewer line.



	2000	2001	2002	2003	2004	2005
Total Spills to Storm Drains and Surface Waters	250	300	250	3300	600	150
Total Spills to Carbonera Creek	250	300	250	3300	400	150

Figure 9. Spill Volumes within the City of Scotts Valley

In the year 2003, a 3,300-gallon spill occurred. This spill is attributed to pump failure at a lift station within the City's jurisdiction. An alarm failed to notify City staff, of the pump failure. Since the day that spill occurred the City implements a "manual activation program" daily to assure alarms work. Each day City staff physically checks each alarm within the entire City system to assure the alarms work. The alarm inspections are a very effective process the city implements to assure alarms work. The City also now inspects pumps at lift stations are a more frequent basis.

The City of Scotts Valley implements a spill management program to minimize the effects of spills upon surface waters. Should a spill occur, the City implements measures to minimize spills to surface waters. In 2005, the City did not have any spills to surface waters.

Based on the information contained above, staff believes collection system spills and leaks are not a significant pathogen source. However, the City of Scotts Valley should continue to implement their Spill Prevention Program as required by their NPDES permit.

Santa Cruz County Sanitation District

The Santa Cruz County Sanitation District operates a collection system for communities east of Santa Cruz such as Soquel and Live Oak. Wastewater discharged to the collection

system flows to the City of Santa Cruz wastewater treatment plant. The County has a force main that lies below the San Lorenzo River substrate. The force main is located just downstream of the Laurel/Broadway Street bridge.

The County Sanitation District implements a maintenance and inspection program for the force main. The program includes a procedure to remove obstacles within the main. The program also includes inspection of the force main to determine if corrosion is occurring. In 2005, a diver inspected the pipe and no corrosion was observed (reference: Phone conversion with Rachel Lather, Senior Civil Engineer, Santa Cruz County Sanitation District February 16, 2006). Staff is not proposing any additional requirements beyond those already required by the County's requirements within the Implementation Plan Chapter.

Storm Drain Discharges

Santa Cruz County Environmental Health Officials sampled storm drains for *E. coli.* The table below shows sampling results.

Table 9. Bacteria Sampling Results at San Lorenzo River Estuary Storm Drains (October 22, 2003-March 02, 2005)

Location	Number of Samples	Average E.coli (#/100 mL)
Mott Street Storm Drain	2	1,680
Gravity Storm Drain at Trestle	13	1,804
Jessie Street Storm Drain	13	1,506
Laurel Street Exit at San Lorenzo River Estuary Storm Drain	12	1,264
Storm Drain at Riverside West	12	601
Broadway Pump Station Storm Drain	13	3,047
West Water Street Storm Drain	12	2,444
Raymond Street at San Lorenzo River	9	2,769
Northeast Pump Bixby at San Lorenzo Blvd	13	2,647

As of the writing of this report, storm drain sampling has not occurred for the Carbonera Creek watershed. However, City of Scotts Valley staff report that City storm drains flow into Carbonera Creek above sampled stations. The Monitoring Plan in Chapter Eleven of this report requires the City of Scotts Valley to sample storm drains. If impairment exists, the sources presented within this report are the likely sources.

Water Board staff believe storm drains are a potential pathogen source. We corroborate this by looking at upstream land uses. There is only a small area upstream of the City of Scotts Valley and this area has only a few homes. Therefore, staff believes septic

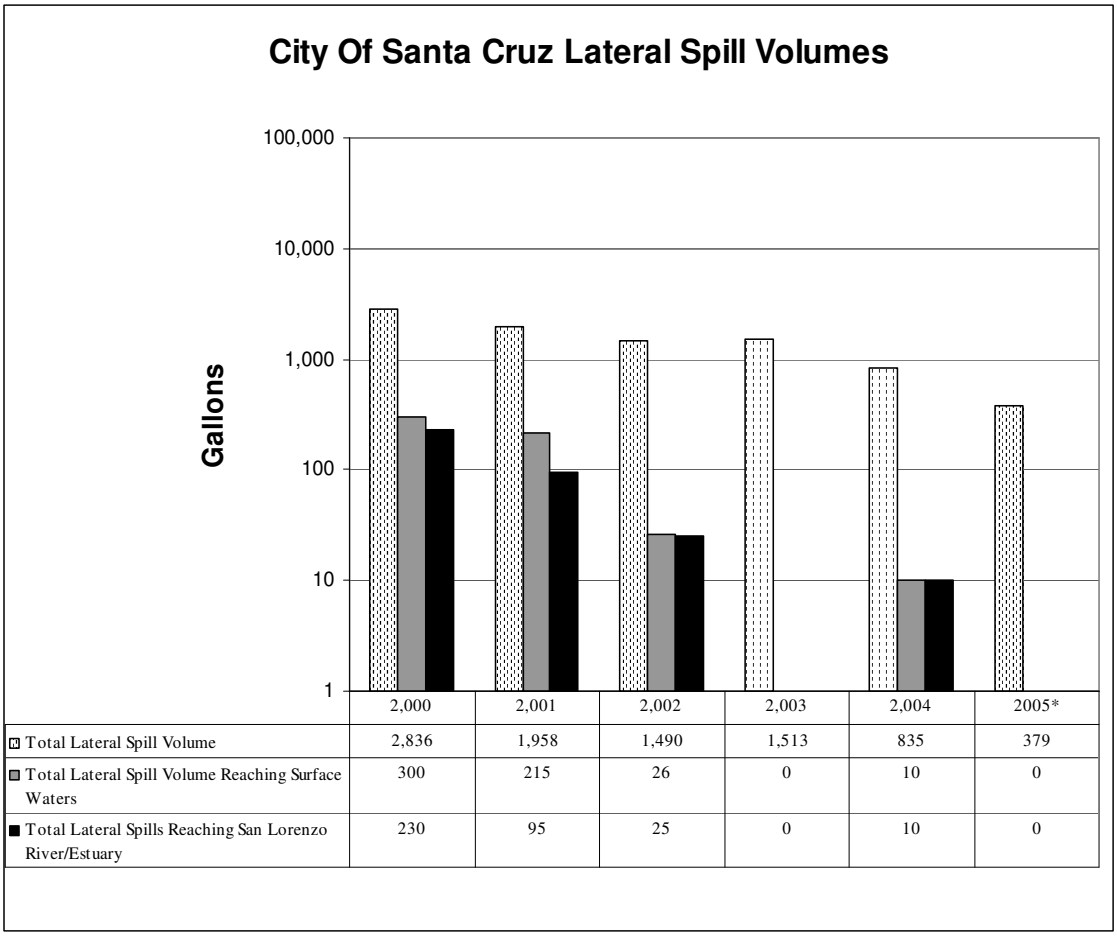
systems are not a likely pathogen source upstream of the City of Scotts Valley. The only other pathogen source may be horse corrals.

Storm drain discharges are expected to contain human waste from municipal system sewage spills/leaks (previously discussed), spills and leaks from private laterals/pump stations, urban runoff, illegal recreational vehicle discharges, and homeless encampments. Storm drain discharges are also expected to contain bird waste (controllable and uncontrollable), pet waste, rodent waste (controllable and uncontrollable), and dumpster leachate.

Private Laterals/Pump Station Spills

The City of Santa Cruz records lateral spill volumes. Reported lateral spills flow to storm drains, surface waters, and streets.

The figure below shows known spill volumes from private laterals within the City of Santa Cruz for the year 2000 through November 04, 2005.



	2,000	2,001	2,002	2,003	2,004	2005*
Total Lateral Spill Volume	2,836	1,958	1,490	1,513	835	379
Total Lateral Spill Volume Reaching Surface Waters	300	215	26	0	10	0
Total Lateral Spills Reaching San Lorenzo River/Estuary	230	95	25	0	10	0

* Year 2005 data is available through 11/04/05

Figure 10. Spill Volumes within the City of Santa Cruz From Private Laterals

The figure above indicates the know*n* spills from laterals ranged from approximately 2836 gallons in the year 2000. Lateral spill volumes significantly reduced since the year 2000. The lateral spill volume in 2005 was 379 gallons. Lateral spill volumes reaching surface waters was 300 gallons in the year 2000, but no lateral spills reached any surface waters in the year 2005.

The City recently implemented spill management practices to prevent lateral spills from flowing to surface waters. The City recently replaced 72 private laterals from the sewer main to the sidewalk with Clean Beach Iniative funds.

Undetected leaks or overflows may be occurring from private laterals. Cracks or poor connections may be causing underground leaks. Small overflows may also occur at lateral cleanouts if the lateral is blocked. We estimate that such leaks or overflows are small in volume, but possibly continuous over days, months or perhaps even years. These types of small volume discharges often occur undetected. John Ricker, from the Santa Cruz Environmental Health Department, has observed sewage leaks at private cleanouts (reference: John Ricker, phone conversation on November 30, 2005). The cumulative effect of such discharges may be large enough to impair the Estuary.

The City of Scotts Valley has had only one known private lateral spill since the year 2000. The City does not record private lateral spills. However, the City of Scotts Valley should record spills volumes from private laterals. The State Water Resources Control Board is scheduled to adopt new requirements. The Water Board will add new requirements to record private lateral spills when adopted by the State Board.

The City of Scotts Valley adopted an ordinance regarding private laterals. The City requires all new laterals to be videoed during after installation to assure the line is not sagging. (Sagging laterals can result in blocked lines or spills.)

Because the City's collection system is relatively new, staff believes problems from private laterals are not a significant problem at this time.

Urban Runoff

Pathogens deposited by human waste, pets, birds, rodents, or wildlife can enter storm drains Water traveling to storm drains can pick up the deposited pathogens. This water originates from a variety of means. One is over watering and allowing runoff to enter streets. Other means is by car washing and other forms of cleaning.

Illegal Recreational Vehicle Discharges

Recreational vehicles may release coliform to the Estuary. Recreation vehicle spills have been reported within the City of Santa Cruz. Many recreational vehicles contain wastewater storage tanks. Some recreational vehicle owners may release wastewater to streets or parking areas if disposal facilities are not available, owners do not want to loose a parking space, or if owners don't want to pay a disposal fee.

Staff believes recreational vehicles are not a problem in the Scotts Valley area based on discussions with City staff. There were no reported spills from recreational vehicles. Furthermore, and a greater reason, is homeless people do not typically reside in recreational vehicles in the Scotts Valley.

Homeless Encampments

Homeless encampments are expected to contain mostly human waste. Other sources such as rodent waste, pet waste, and bird waste may occur from homeless encampments.

Homeless persons use the San Lorenzo River and the upstream watershed. Homeless encampments may be a significant human bacteria source. For example, the October 22, 2005 issue of the Santa Cruz Sentinel reported a well-established homeless community on Carbonera Creek. According to John Ricker, human waste was found ten feet from the creek. Other similar sites likely exist within the San Lorenzo River watershed. Downstream sampling has not confirmed a bacteriologic impact from homeless encampments, but during high flow periods, waste is expected to enter the River and creeks.

According to the City of Scotts Valley Source Control Manager, homeless persons are not a problem in Santa Cruz (reference: Jim Crowley, phone conversion January 30, 2006).

Controllable Bird Waste Transport Mechanisms

Microbial source tracking results indicate birds contribute bacteria to the Estuary. Controllable sources of bird waste may be dumpsters and trashcans. Birds may frequent these locations as feeding sites. Bird waste may leach to stormdrains or surface waters when storms occur.

Pet Waste Transport Mechanisms

Microbial source tracking results indicate dog waste is present in the Estuary. According to the Prop 13 report, one storm drain discharge provided a sizeable contribution from dogs. Pet wastes can reach the Estuary via storm drain discharges during wet seasons. Also pet wastes can reach storm drains during dry seasons if wash water comes into

contact with pet droppings.

Controllable Rodent Waste Transport Mechanisms

Microbial source tracking results indicate rodents contribute bacteria to the Estuary. Controllable rodents waste can reach the estuary the same way that bird waste can reach the Estuary.

Dumpster Leachate

When it rains, rainwater can enter dumpsters and discharge leachate. This occurs when dumpsters are uncovered and containers leak.

During dry seasons, bird waste may reach surface waters when trash-holding areas are washed down. Wash down waters may reach stormwater drains and surface waters

The table above shows all storm drains exceed the maximum EPA criteria (235/100 mL).

The City of Santa Cruz recently received funds to install a dry weather diversion system. The diversion will occur at two pump stations within the City. Dry weather storm water will not discharge to San Lorenzo River. (One of the diversions was installed during the summer of 2005.) Instead, the storm water will be diverted to the City's wastewater treatment system and discharged to the City's outfall. We expect the dry weather diversion to greatly improve the Estuary's water quality during the summer.

Occasional Septic System Failures

Occasional septic system failures are expected to contain mostly human waste. Other sources such as rodent waste or pet waste may occur in septic system discharges.

Based on winter inspections performed by the County, only 1-5 % of the San Lorenzo River watershed's 13,000 septic systems fail even during a wet winter (*San Lorenzo Wastewater Management Plan Program Status Report*, 1999-2001. When failures occur during wet periods partially treated sewage flows to ditches, roadways, creeks, and the River. During dry periods, sewage from failing septic systems probably will not reach a waterway unless a failure occurs close to a creek or to the River.

The County of Santa Cruz implements a Wastewater Management Plan to reduce possible water quality impacts from septic systems. The plan has been implemented since 1987 and requires system upgrades, improved creek setbacks, and failing systems identification. Staff opinion is that San Lorenzo River at Sycamore Grove (upstream of the Estuary and downstream of septic systems) is not impaired

Of all the human sources, staff believes septic system failures are not a significant source. This is demonstrated by fecal coliform data for the San Lorenzo River at Sycamore Grove station. This station is not impaired for fecal coliform. (Please see Appendix B of this report for more information regarding this station.). The San Lorenzo River upstream of Sycamore Grove at the "Big Trees" station rarely exceeds objectives (California Regional Water Board *San Lorenzo River Pathogen Project Plan*, June 1, 2004).

Farm Animals and Livestock

Cow Waste Transport Mechanisms

Microbial source tracking results indicate cows contribute bacteria to the Estuary.

Runoff during storms from areas occupied by cows and from manure stockpiles contribute fecal coliform. Animals allowed into creeks during non-storm periods can also contribute fecal coliform.

Horse Waste Transport Mechanisms

Microbial source tracking results indicate horses contribute bacteria to the Estuary. Horse wastes reach the Estuary the same way cow waste reaches the estuary. (The cow waste transport mechanism is discussed above.)

WASTE DISCHARGES NOT SUBJECT TO REGULATION BY THE WATER BOARD

The Water Board only has authority to regulate waste discharges. The Water Board does not have authority to regulate natural discharges from wildlife.

Birds and other wildlife (beaver, deer, otter, raccoons) are the largest *E.coli* sources. Bird wastes enter the Estuary from roosting areas in close proximity to the Estuary or upstream waters. Wildlife droppings in close proximity to the Estuary or upstream waters also contribute *E.coli*.

These sources are not subject to waste discharge regulation by the Water Board. Agencies in charge of land use have authority to require practices that reduce contributions from these sources. For example, Cities can require landowners to install devices that prevent bird-landing areas. Such devices could reduce the quantity of bird excrement that reaches surface waters during storms or during washings.

4.2. Source Analysis Conclusions

San Lorenzo River Estuary

In an effort to attempt to determine the areas where bacteria sources are contributing to pathogen impairment, the Proposition 13 Report provided a mass balance calculation for the San Lorenzo River Estuary. The analysis was performed for the summer only because that was the only time that flow data for various pump stations was available. Water flows into the Estuary from the San Lorenzo River upstream of the Estuary, Branciforte Creek, and a number of storm drain pump stations. For each of these sites, summer bacteria sampling results were analyzed. For surface water stations, fecal coliform data is available. For pump stations, *E.coli* data is available.

Table 10. Estimated Bacteria Load from Various Sources in the Lower San Lorenzo River (Based on Flow Estimates and Bacteria Levels)

Location	Flow (cfs)	Fecal coliform (#/100mL)	*E.coli* (#/100 mL)	Bacteria Load	Percent Contribution to Load	Possible Souces[1]
San Lorenzo River above Hwy One	5	61		305	16%	Homeless Encampments, Occasional Septic System Failures, Illegal Recreational Vehicle Discharges, Pet Wastes, and Livestock
Branciforte Cr.	1	70		70	4%	Sewage Spills and Leaks from Municipal Collection System and Private Laterals; Homeless Encampments; Occasional Septic System Failures; Pet Wastes; and Livestock
Unknown	0.2	4200		840	44%	From Birds?
Pump 1b-Uhden	0.2		219	44	2%	Sewage Spills and Leaks from Municipal Collection System and Private Laterals; and Pet Wastes
Pump 3 Water St.	0			0	0%	Sewage Spills and Leaks from Sewage Spills and Leaks from Municipal Collection System and Private Laterals; and Pet Wastes
Pump 1-Laurel	0.2		262	52	3%	Sewage Spills and Leaks from Municipal Collection System and Private Laterals; and Pet Wastes
Pump 1a-Boardwalk	0.2		2213	443	23%	Sewage Spills and Leaks from Municipal Collection System and Private Laterals; and Pet Wastes
Pump 2-Bixby	0.2		712	142	7%	Sewage Spills and Leaks from Municipal Collection System and Private Laterals; and Pet Wastes

Larry, please insert figures showing pump station locations.

Figure 11. Street and Pump Locations

The table above indicates that 20% of the bacteria flows into the Estuary from upstream sources. The table also indicates that 35 % of the bacteria flows into the Estuary from urban areas. Approximately 44% of the bacteria originate from unknown sources. The unknown source is suspected to be mostly birds, however rodents and wildlife are a likely contribution as well.

Carbonera Creek

Staff analyzed potential Carbonera Creek sources within this chapter. The Water Board needs more sampling data to determine if management measures are necessary.

5. CRITICAL CONDITIONS AND SEASONAL VARIATION

This section discusses factors affecting impairment, critical conditions, and seasonal fecal coliform variations.

5.1. Impairment Factors and Critical Conditions

Many factors influence San Lorenzo River Estuary and Carbonera Creek impairment. These factors include the following: (1) discharge of pathogens to the Estuary and Carbonera Creek, (2) stream flow transmission, and (3) survival and possible fecal coliform population growth.

Fecal coliform discharge will increase the fecal coliform population. Possible discharge sources are mentioned in Chapter Four.

Stream flows may serve to either increase or dilute fecal coliform concentrations. Stagnant pools may be areas where fecal coliform increases due to evaporation. Conversely, increases stream flows may dilute fecal coliform concentrations.

Bacteria sources may seed sediments and promote ongoing fecal coliform growth. The Puget Sound area has experienced significant fecal coliform growth. Fecal coliform growth in the San Lorenzo River Estuary is not very significant (Prop 13 Report). Fecal coliform grown is suspected in Camp Evers Creek (which flows to Carbonera Creek). The Camp Evers at Whispering Pines station is stagnant and ponding at this site may facilitate pathogen growth.

5.2. Seasonal Variations

The following table analyzes San Lorenzo River Estuary fecal coliform data on a seasonal basis. This table shows stream flow is not a critical factor. However, the proportion of human contribution to fecal coliform is significantly higher during wet periods (see Table Four).

San Lorenzo River Estuary

The table below analyzes monthly water quality objective exceedance. The table provides seasonal trend conclusions for each San Lorenzo River monitoring station.

Table 11. San Lorenzo River Estuary Seasonal Analysis

Station	Water Quality Objective	Statistical Value	Months Exceeding Water Quality Objective	Comments
San Lorenzo River Lagoon @ Trestle	Geomean	Mean	June, July, Sept-Dec	No Seasonal Trend
		Median	July, Sept-Dec	
	Not to Exceed	Mean	Feb, May-Dec	
		Median	Oct	
San Lorenzo River Lagoon at Broadway/Laurel Bridge	Geomean	Mean	Jan, Feb, June-Dec	No Seasonal Trend
		Median	June, July, Sept-Dec	
	Not to Exceed	Mean	Feb, July-Dec	
		Median	Oct, Nov	
San Lorenzo River @ Soquel Avenue Bridge	Geomean	Mean	Not enough samples to compute geometric means	No Seasonal Trend
		Median	Not enough samples to compute geometric means	
	Not to Exceed	Mean	Jan, Apr, May, Aug, Oct-Dec	
		Median	Jan, Apr-June, Aug, Dec	
San Lorenzo River at Sycamore Grove	Geomean	Mean	None	Attains Water Quality Objectives
		Median	None	
	Not to Exceed	Mean	None	
		Median	None	
Branciforte Creek @ San Lorenzo River	Geomean	Mean	Not enough samples to compute geometric means	Insufficient Samples to determine seasonal variations or impairment
		Median	Not enough samples to compute geometric means	
	Not to Exceed	Mean	Jan, Feb, May, June, Aug-Dec	
		Median	May, June, Aug, Sept	
Branciforte Creek @ Carbonera Creek	Geomean	Mean	Not enough samples to compute geometric means	Insufficient Samples to determine seasonal variations or impairment
		Median	Not enough samples to compute geometric means	
	Not to Exceed	Mean	None	
		Median	None	
Branciforte Creek @ Isbel Drive	Geomean	Mean	Not enough samples to compute geometric means	Attains Water Quality Objectives
		Median	Not enough samples to compute geometric means	
	Not to	Mean	Apr	

Station	Water Quality Objective	Statistical Value	Months Exceeding Water Quality Objective	Comments
		Median	None	
Carbonera Creek @ Branciforte Creek	Geomean	Mean	Not enough samples to compute geometric means	Insufficient Samples to determine seasonal variations or impairment
		Median	Not enough samples to compute geometric means	
	Not to Exceed	Mean	None	
		Median	None	

All three sample sites in the Estuary (San Lorenzo River Lagoon@ Trestle, San Lorenzo River Lagoon @ Broadway/Laurel Bridge, and San Lorenzo River @ Soquel Avenue Bridge) generally respond the same spatially and temporally. Most stations on the Branciforte and Carbonera Creek have insufficient data to make any kind of impairment conclusions.

Conclusion

Though several conditions potentially account for the documented impairment, no critical conditions are confirmed. Therefore, load allocations and numeric targets are not adjusted to account for critical conditions.

Although the proportion of human contribution was significantly higher during wet periods at the San Lorenzo River Estuary, the three Estuary stations showed no seasonal variations in fecal coliform exceedance. Therefore, load allocations and numeric targets were not adjusted for seasonal variation. The numeric targets provided in Chapter Six apply to both wet and dry weather.

6. NUMERIC TARGET

6.1. Numeric Targets

The *Water Quality Control Plan, Central Coast Region* (Basin Plan) contains the following discharge prohibition on Chapter Five, Section IV.B.

> "Waste discharges to the following inland waters are prohibited:…All surface waters within the San Lorenzo River, Aptos-Soquel, and San Antonio Creek Subbasins and all water contact recreation areas except where benefits can be realized from direct discharge of reclaimed water."

The above prohibition is clear. No waste discharges are allowed in San Lorenzo River subbasins. San Lorenzo River Estuary and Carbonera Creek are both within the San Lorenzo River subbasins.

In addition to the above waste discharge prohibition, the Basin Plan contains fecal coliform water quality objectives. The fecal coliform numeric targets for San Lorenzo River Estuary and Carbonera Creek are based on current Basin Plan water contact recreation objectives. (Staff is proposing to remove the shellfish beneficial use for San Lorenzo River Estuary from the Basin Plan.)

Table 12. Numeric Fecal Coliform Targets for San Lorenzo River Estuary and Carbonera Creek

Fecal Coliform	
Geometric Mean	**Maximum**
200 MPN/100 mL[a]	400 MPN/100 mL[b]

a: Geometric mean of not less than five samples over a period of 30 days
b: Not more than 10% of total samples during a period of 30 days exceed
Source: Regional Water Quality Control Board, Basin Plan 1994.

7. LINKAGE ANALYSIS

The goal of the linkage analysis is to establish a link between pollutant loads and water quality. This, in turn, supports that the loading capacity specified in the TMDL will result in attaining the numeric target. For this TMDL, this link is established because the numeric targets are the TMDL. The numeric targets are protective of all the beneficial uses.

8. TMDL CALCULATION AND ALLOCATIONS

A TMDL is the pollutant loading capacity that a water body can accept while protecting beneficial uses. Usually, TMDLs are expressed as loads (mass of pollutant calculated from concentration multiplied by the volumetric flow rate), but in the case of pathogens, it is more logical for the TMDL to be based only on concentration. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure [40 CFR §130.2(I)]. A concentration based TMDL makes more sense in this situation because the public health risks associated with recreating in contaminated waters scales with organism concentration, and pathogens are not readily controlled on a mass basis. Therefore, we are establishing a concentration-based TMDL for pathogens in San Lorenzo River Estuary. The TMDL is the same set of concentrations as were proposed in the numeric targets section.

Table 13. TMDL for San Lorenzo River Estuary and Carbonera Creek

Fecal Coliform	
Geometric Mean	**Maximum**
200 MPN/100 mL[a]	400 MPN/100 mL[b]

a: Geometric mean of not less than five samples over a period of 30 days
b: Not more than 10% of total samples during a period of 30 days exceed

8.1. Proposed Load Allocations

The load allocation for all non-natural (controllable) sources will be equal to the fecal coliform target shown in Table Nine. These sources shall not discharge or release a "load" of bacteria that will increase the load above the assimilative capacity of the water body. All Estuary areas and Carbonera Creek areas will be held to these load allocations.

Should all control measures be in place and fecal coliform levels remain high, investigation will take place to determine if the high level of fecal coliform is due to natural sources.

Insert Table Heading

ALLOCATIONS AND RESPONSIBLE PARTIES

WASTE LOAD ALLOCATIONS		Receiving Water Fecal Coliform (MPN/100mL)[1]
Waterbody	**Responsible Party**	
San Lorenzo River, Branciforte Creek, and Carbonera Creek	City of Santa Cruz Municipal Sewer Collection System	≤ 200
San Lorenzo River, Branciforte Creek, and Carbonera Creek	City of Santa Cruz (Stormwater)	≤ 200
Camp Evers Creek and Carbonera Creek	City of Scotts Valley (Stormwater)	≤ 200
San Lorenzo River, Branciforte Creek, and Carbonera Creek	Santa Cruz County (Stormwater)	≤ 200
San Lorenzo River, Branciforte Creek, and Carbonera Creek	Santa Cruz County (Homeless Encampments)	≤ 200
LOAD ALLOCATIONS		**Receiving Water Fecal Coliform (MPN/100mL)[1]**
San Lorenzo River, Branciforte Creek, and Carbonera Creek	City of Santa Cruz (Illegal Recreational Vehicle Discharges)	≤ 200
San Lorenzo River, Branciforte Creek, and Carbonera Creek	Operators or owners of livestock facilities and animals	≤ 200
[1] As log mean of five (5) samples taken in a 30-day period occurring within each season.		

8.2. Margin of Safety

The margin of safety is a required component of a TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water (CWA 303(d)(1)(C)). For pathogens in San Lorenzo River Estuary and Carbonera Creek, a margin of safety has been established implicitly through the use of protective numeric targets, which are in this case the water quality objectives for the Estuary beneficial uses.

The pathogen TMDL for San Lorenzo River Estuary and Carbonera Creek is the water quality objective for water contact recreation. The Central Coast Region Water Quality Control Plan states that, "Controllable water quality shall conform to the water quality objectives..." When other conditions cause degradation of water quality beyond the levels or limits established as water quality objectives, controllable conditions shall not cause further degradation of water quality" (Basin Plan, p. III-2). Because the allocation for controllable sources is set at the water quality objective, if achieved, these allocations will by definition achieve the water quality objectives. Thus, in this TMDL there is no uncertainty relative to the load effect from controlled sources on water quality.

However, in certain locations there is a distinct possibility that non-controllable, or, natural sources will themselves occur at levels exceeding water quality objectives. And while it is controllable water quality conditions ("actions or circumstances resulting from man's activities" (Basin Plan, p. III-2)) that must conform to water quality objectives,

receiving water quality will contain discharge from both controllable and natural sources.

The ability to differentiate the controlled from the natural sources is the chief uncertainty in this TMDL. Monitoring of both discharges to and receiving water of the San Lorenzo River Estuary and Carbonera Creek will indicate whether the allocations from controllable sources are met, thereby minimizing any uncertainty about the impacts of loads on the water quality.

9. PUBLIC PARTICIPATION

Public participation began when the County developed a report required by Proposition 13 Grant Funds. The grant required a Technical Advisory Committee to meet periodically.

Public participation will occur as part of the Water Board and State Board TMDL adoption process. The Water Board will adopt a Basin Plan amendment incorporating relevant portions of the TMDL into the Basin Plan.

10. IMPLEMENTATION PLAN

10.1. Introduction

The purpose of the Implementation Plan is to describe the steps necessary to reduce pathogen loads and to achieve this TMDL. The Implementation Plan identifies the following: actions that staff expect would reduce pathogen loading; parties responsible for taking these actions; regulatory mechanisms by which the Water Board will assure these actions are taken; reporting and evaluation requirements that will indicate progress toward completing the actions; and a timeline for completion of implementation actions. A monitoring plan designed to measure progress toward water quality goals is included in the following chapter.

10.2. Implementation Actions

Sewage Spills and Leaks for Municipal Systems

Existing Control Mechanism

The Water Board has issued a National Pollutant Discharge Elimination System (NPDES) permit to the City of Santa Cruz and to the City of Scotts Valley. The Water Board has also issued Waste Discharge Requirements (WDR) to Santa Cruz County Sanitation District.

The City of Santa Cruz and Scotts Valley NPDES permits and the County of Santa Cruz WDR requires the Cities and the County to implement a Collection System Management Plan (CSMP). CSMP requirements are shown below.

To control collection system discharges, the Water Board requires a CSMP. CSMP components include the following: (1) complete testing and proactive upgrade of sewer lines; (2) proactive sewer line maintenance, and (3) spill prevention and cleanup improvements.

Requirements for the City of Santa Cruz

As mentioned in Chapter Four, Source Analysis, the City still needs to assess sewer conditions upstream of Water Street. The City must include future sewer assessment and line maintenance work in this area in future budgets. The City should initially focus efforts and repairs on sewers within 100 feet of San Lorenzo River, Branciforte Creek, and Carbonera Creek. The City also needs to eventually focus efforts on the remaining sewers located further than 100 feet from the San Lorenzo River, Branciforte Creek and Carbonera Creek located within the San Lorenzo River watershed.

Requirements for the City of Scotts Valley and Santa Cruz County Sanitation District

Staff opinion is these agencies are satisfactorily implementing the CSMP. No additional requirements are necessary.

Storm Drain Discharges

Existing Control Mechanisms

The State Water Resources Control Board adopted a General Permit for storm water discharge. The General Permit requires smaller municipal dischargers, such as the City/County of Santa Cruz and the City of Scotts Valley, to develop and implement a Storm Water Management Plan (SWMP). The SWMP goal is to reduce pollutant discharge to the maximum extent practicable. The management programs must specify what best management practices the municipality will use to address certain program areas. The program areas include public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping for municipal operations.

At the time of writing this report, the Water Board has not approved a SWMP for the City/County of Santa Cruz or the City of Scotts Valley.

Requirements for the City of Santa Cruz: Private Lateral/Pump Station Spills

The Water Board should adopt a SWMP to minimize fecal coliform contributions to storm drains. Storm drains must not contain wastes from private lateral and pump station spills.

As mentioned above, one component of the General Permit requires the City to develop, implement and enforce a plan to detect and eliminate illicit discharges to the storm drain. The Code of Federal Regulations defines an illicit discharge (40 CFR §122.26(b)(2)). An illicit discharge means "any discharge to a municipal separate storm sewer that is not composed entirely of storm water except discharges pursuant to a NPDES permit (other than the NPDES permit for discharges from the municipal separate storm sewer) and discharges resulting from fire fighting activities." A municipal separate storm sewer means a "conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains.)" (40 CFR §122.26(b)(8)). There are a variety of potential illicit discharges. This section discusses the types of illicit discharges the City of Santa Cruz must consider with the SWMP.

The City must correct discharges resulting from private lateral spills. The City must

include a plan to correct spills/leaks from private laterals in the SWMP. We offer the following as some suggestions for the City's SWMP. The City should consider implementing a program to require inspection or testing and upgrade at time of property transfer (at a minimum). The City should also target testing in areas where subsurface contamination and migration to the San Lorenzo River Estuary can occur. The City should develop a finance program to provide incentive to property owners to replace problem laterals. The City should also implement a two or three strikes program to require lateral replacement after two or three spills. If they are not corrected, the City should utilize it's authority to correct private lateral problems and bill the property owner.

Requirements for City of Scotts Valley

Sewage spills occur on private property. These spills originate from pump stations and private laterals. For private laterals, we offer the same suggestions for the City of Scotts Valley as provided above for the City of Santa Cruz. In addition, the City must correct pump station failures that occur on private property.

Requirements for City and County of Santa Cruz and City of Scotts Valley (Agencies): Urban Runoff

The City/County of Santa Cruz and the City of Scotts Valley (agencies) must address discharges of relatively clean water that may pick up accumulated fecal coliform while traveling to storm drains and creeks. Some preventative measures include:

1. Eliminate over watering and runoff of irrigation water into the street;
2. Either take cars to a carwash or wash them at locations that won't run into the street;
3. Discharge wash water from carpet cleaning, mop buckets, floor mat washing, etc. should be discharged to the sanitary sewer;
4. Clean up spills with mops or absorbent material rather that washing into a gutter or storm drain inlet; and
5. Provide education regarding preventing storm drain discharges

The agencies must also help prevent bacteria from reaching storm drains by maintaining the street sweeping program. The City should increase street sweeping just before the first rains of the season to capture leaves and mud that incubates bacteria.

The agencies should also continue to regularly clean storm drains to remove silt and organic material accumulations, particularly before the first storm of the season.

Requirements for City and County of Santa Cruz and City of Scotts Valley (Agencies): Pet Wastes

The agencies must reduce pet waste loading. Pet waste management measures include developing and implementing enforceable means (e.g. an ordinance) for reducing and/or

eliminating fecal coliform loading from pet waste into Carbonera Creek, Branciforte Creek, and the San Lorenzo River Estuary. Cities and counties throughout the United States have adopted ordinances requiring pet owners to pick up their pet litter and dispose of it appropriately. While these are commonly enforced in public places, pet waste on a pet owner's property or residence may also be at risk of entering waterways (e.g. backyards contiguous with, or, abutting waterways) if not disposed of properly. Therefore, Santa Cruz and Scotts Valley should undertake additional measures to educate residents and homeowners whose properties abut riparian areas and waterways regarding the vulnerability of these areas to pollution from domestic cat, dog, and other pet waste.

Requirements for City and County of Santa Cruz and City of Scotts Valley (Agencies): Dumpster Leachate

Dumpsters/receptacles serving restaurants or other facilities within the agencies' jurisdiction must not discharge leachate. Dumpsters should always be covered and be replaced when leaks occur.

Requirements for City and County of Santa Cruz and City of Scotts Valley (Agencies): Controllable Rodent, Bird, and Wildlife Waste

The agencies must determine controllable wastes associated with rodents, birds, and wildlife. The City should develop and implement a plan to control these wastes. For example, dumpsters and trash receptacles should be covered to minimize potential impacts of leachate, rodents, birds, and wildlife.

Requirements for City and County of Santa Cruz and City of Scotts Valley (Agencies): Public Education

Agency Storm Water Management Plans need to include public participation and outreach goals that translate into education about specific sources of storm water pollution. The Plans should include appropriate departments or agencies within both Cities and the County that must implement management measures. The Cities and County must also identify how and when they will educate the public about management measures. Also the Cities and County must develop and implement enforceable means of reducing fecal coliform loading to stormwater. SWMPs must determine the mechanisms specific target populations will be reached, including the homeless.

Chapter Eleven of this document requires agencies to sample water quality and provide particular types of analysis. The SWMP must include methods the agency will use to disseminate the analysis results. This information will help the public and agencies determine if controllable sources (such as human waste and pet waste) is present. This, in turn, will help provide the public with information they need to support appropriate agency's necessary management measures.

Septic System Failures

Existing Control Mechanism

Septic system failures may occur within the watershed. Septic system failures occurs for the following reasons ("Draft Wastewater Management Plan for the San Lorenzo River Watershed," February 1995):

1. small lots may limit disposal area,
2. substandard systems are installed,
3. old septic systems,
4. system is located too close to a stream, and/or
5. system is located at a shallow ground water area.

The Water Board addressed septic system failures in the San Lorenzo River watershed by adopting a Basin Plan prohibition. The prohibition requires the County to implement the "Wastewater Management Plan for the San Lorenzo River Watershed" dated February 1995. The Plan elements include the following.

1. inspection and evaluation of existing onsite disposal systems;
2. disposal system improvements for malfunctioning systems;
3. ongoing system inspection and maintenance;
4. community disposal systems development;
5. wastewater disposal management from new development;
6. water quality monitoring; and
7. implementation schedule.

The existing control mechanism is effective and no additional requirements are necessary.

Farm Animals and Livestock; Homeless Encampments; and Illegal Recreational Vehicle Discharges

As shown earlier in this report, cows and horses contribute a small portion of the fecal coliform to the watershed. Other potential farm animals sources include emu, goat, and other livestock The Santa Cruz County Environmental Health Department has had success with runoff and manure management at many of the larger operations.

Also earlier in this report, homeless encampments and illegal recreational vehicles also are likely fecal coliform contributors.

Existing Control Mechanism

As mentioned in Chapter Six, Numeric Targets, the *Water Quality Control Plan, Central*

Coast Region (Basin Plan) contains the following discharge prohibition on Chapter Five, Section IV.B.

> "Waste discharges to the following inland waters are prohibited:…All surface waters within the San Lorenzo River, Aptos-Soquel, and San Antonio Creek Subbasins and all water contact recreation areas except where benefits can be realized from direct discharge of reclaimed water."

The above prohibition is clear. No waste discharges are allowed in San Lorenzo River subbasins. San Lorenzo River Estuary and Carbonera Creek are both within the San Lorenzo River subbasins.

Staff believes the Water Board should utilize the Basin Plan prohibition to prevent discharges to the San Lorenzo River Estuary, Branciforte Creek, and Carbonera Creek. This section below provides actions necessary to comply with the Basin Plan prohibition.

Exiting Control Mechanism

The *Nonpoint Source Implementation and Enforcement Policy*, adopted as state law in August 2004, requires the Regional Water Boards to regulate all nonpoint sources (NPS) of pollution using the administrative permitting authorities provided by the Porter-Cologne Act. Dischargers must comply with Waste Discharge Requirements (WDRs), waivers of WDRs, or Basin Plan Prohibitions, by participating in the development and implementation of Nonpoint Source Pollution Control Implementation Programs, either individually or collectively as participants in third-party coalitions. (The "third-party" Programs are restricted to entities that are not actual discharges under Regional Water Board permitting and enforcement jurisdiction. These may include Non Governmental Organizations, citizen groups, industry groups, watershed coalitions, government agencies, or any mix of the above. All Programs must meet the requirements of the following five key elements described in the NPS Implementation and Enforcement Policy. Each Program must be endorsed or approved by the Regional Water Board.

Key Element 1**:** *A* Nonpoint Source Pollution Control Implementation Program's ultimate purpose must be explicitly stated and at a minimum address NPS pollution control in a manner that achieves and maintains water quality objectives.

Key Element 2**:** The Program shall include a description of the management practices (MPs) and other program elements dischargers expect to implement, along with an evaluation program that ensures proper implementation and verification.

Key Element 3**:** The Program shall include a time schedule and quantifiable milestones, should the Regional Water Board require these.

Key Element 4**:** The Program shall include sufficient feedback mechanisms so that the Regional Water Board, dischargers, and the public can determine if the

implementation program is achieving its stated purpose(s), or whether additional or different MPs or other actions are required (See Section 10, Monitoring Program).

Key Element 5**:** Each Regional Water Board shall make clear, in advance, the potential consequences for failure to achieve a Program'*s* objectives, emphasizing that it is the responsibility of individual dischargers to take all necessary implementation actions to meet water quality requirements.

Within nine months following approval of this TMDL by the Water Board, the Executive Officer of the Water Board will issue a letter to the following three entities: (1) operators and/or owners of livestock facilities and animals; (2) Santa Cruz County Environmental Health Department (to develop a homeless encampment discharge mitigation plan); and (3) City of Santa Cruz (to develop an illegal recreational vehicle discharge mitigation plan). The Water Board letter will require these three entities to submit within six months either: 1) an approvable Nonpoint Source Pollution Implementation Control Program (Program) consistent with the State's Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program; or 2) documentation that identified activities do not cause waste to pass into waters of the state within the Carbonera Creek, Branciforte Creek, and San Lorenzo River Estuary Watershed (documentation). Alternatively, dischargers may immediately cease all discharges in violation of the San Lorenzo waste discharge prohibition.

The Executive Officer will review and approve or request modification of the Program or documentation within six months. Should the Program or documentation require modification, or, should a party fail to submit a Program or documentation, the Executive Officer may impose civil liability pursuant to section 13268 of the California Water Code, or recommend or initiate enforcement action for violation of the prohibition. Alternatively, the Water Board can issue individual or general waste discharge requirements to assure compliance with the prohibition provided that the dischargers in question submit the necessary Program or documentation.

Requirements for the County of Santa Cruz

Homeless encampments are a problem within the County areas upstream of the City of Santa Cruz. The Water Board has adopted a discharge prohibition the San Lorenzo River watershed within the Basin Plan. Homeless encampments must comply with this discharge prohibition. The County must develop a plan to assure homeless encampment discharges to not reach waters within the San Lorenzo River watershed.

The County of Santa Cruz must develop a plan to encourage proper disposal from homeless encampments. The County must develop and implement strategies to reduce and/or eliminate fecal coliform loading. The County will be required to assess homeless encampment discharge pathogen loading and describe steps they are taking to insure any pathogen loading is minimized or eliminated, through preparation and submittal to the Water Board, of a Nonpoint Source Pollution Control Implementation Program.

Requirements for the City of Santa Cruz

Illegal recreational vehicle discharge management measures must be developed. The City has taken some steps to address this issue, such as overnight parking prohibitions in some areas. However, the threat of parking citations are not an effective means of addressing wastes stored in vehicles. Other communities such as the City of Santa Barbara have implemented actions to properly dispose of waste from these vehicles. Santa Barbara County allows legal overnight parking at the County Building and access to toilet facilities. Santa Barbara County also uses "legal and free" RV disposal program. A waste disposal companies provides free facilities for RV waste. Santa Barbara County provides informational flyers explaining these services to suspected inhabited recreational vehicles. Another approach Santa Barbara County uses is to provide porta-potties along creeks and areas occupied by homeless people.

The City of Santa Cruz must develop a plan to encourage proper disposal for illegal vehicles. The City must develop and implement strategies to reduce and/or eliminate fecal coliform loading. The City will be required to assess illegal vehicle discharge pathogen loading and describe steps they are taking to insure any pathogen loading is minimized or eliminated, through preparation and submittal to the Water Board, of a Nonpoint Source Pollution Control Implementation Program.

Requirements for Land Owners

Operators and/or owners of livestock facilities and animals must develop and implement strategies to reduce and/or eliminate fecal coliform loading. They will be required to assess their contribution to pathogen loading and describe steps they are taking to insure any pathogen loading is minimized or eliminated, through preparation and submittal to the Water Board, of a Nonpoint Source Pollution Control Implementation Program.

County of Santa Cruz zoning regulations state that the use of stables, paddocks, or corrals must be accompanied by an erosion control plan prepared pursuant to Section 16.22.060 of County Planning and Zoning Regulations. Because rainfall runoff transports sediment and manure similarly, compliance with these County regulations could result in at least partial completion of this TMDL Implementation Action. However, additional measures are required for facilities that allow manure to come into contact with rainwater and enter surface waters through runoff. Through preparation of a *Nonpoint Source Pollution Control Implementation Program* operators or owners of such facilities could identify manure management measures, such as:

- Runoff management, including diversion of clean water from contact with holding pens, animals, and manure storage facilities through the use of berms, diversions, roofs, or enclosures
- Grass waterways
- Critical plantings

- Filter strips
- Composting manure
- Daily clean up

(Ecology Action has obtained Prop 13 Grant Funds to improve water quality discharges resulting from livestock operations. The Grant includes the following tasks: (1) workshops to present pollution prevention approaches, (2) a pollution reduction demonstration, (3) peer recognition at an awards ceremony for facilities that have implemented or maintained exemplary management practices, and (4) a Feasibility and Market Study or a pilot manure hauling/composting service. This project is a joint effort of the Ecology Action, Santa Cruz County Resource Conservation District, and the Santa Cruz Horsemen's Association.)

10.3. Regulatory Mechanism and Reporting Requirement

Implementation actions are required through existing or anticipated regulatory mechanisms. Regulatory mechanisms requiring implementation actions include:

1. National Pollutant Discharge Elimination System (NPDES) permits
    a. Existing Collection System Management Plan (CSMP) requirements the City of Santa Cruz contained in Waste Discharge Requirements (WDR) Order R3-2005-0003 NPDES Permit No. CA 0048194
    b. Anticipated Storm Water Discharges from Small Municipal Separate Storm Sewer Systems requirements (Small MS4 Permit) for the City and County of Santa Cruz and the City of Scotts Valley
2. Enforcement Provisions
    (See discussion below.)
3. Reporting and Monitoring pursuant to Section 13267 or 13383 of the California Water Code. The Water Board can use this mechanism to request monitoring and/or technical reports. The Water Board can also establish monitoring, inspection, entry, reporting, and record keeping requirements.

NPDES Permit. Regional Water Board staff will evaluate Collection System Management Plans developed by the City and County to verify completion of specific actions required in this chapter. Agencies will report to the Water Board in accordance with the permit requirements.

This TMDL Implementation Plan requires specific components for the Stormwater Management Plans developed pursuant to the Small MS4 Permit. These components will indicate how the City and County plan to achieve specific actions required in this chapter. The discharger will submit annual reports (required of small MS4 permit enrollees) to the Water Board.

Enforcement Provisions

The Water Board will define and identify violations of the prohibition and NPDES permits through: review of TMDL implementation reports submitted by responsible parties, scheduled inspections of permitted facilities, reconnaissance, review of information presented in response to 13267 letters, and through response to complaints. "Individual dischargers, including both landowners and operators, continue to bear ultimate responsibility for complying with a Water Board's water quality requirements and orders. All Water Board enforcement actions taken will be taken against non-compliant individual dischargers, not third-party representatives. All enforcement actions taken shall be consistent with the SWRCB [State Water Board] Enforcement Policy (SWRCB 2002)," (SWRCB, 2004a).

10.4. Summary of Required Actions

The following table outlines the schedule of required implementation actions. The actions in the table below represent minimum actions and schedules required. The Water Board may, at its discretion, alter the tasks defined below if sufficient water quality improvements are not realized. The Water Board will make modifications to the tasks listed below pursuant to, but not limited to, the regulatory mechanisms articulated in the table. Also note that tasks requiring monitoring activities refer to monitoring efforts that are described in the Monitoring Plan, which is outlined in the next chapter of this document.

Table 14. Schedule and Trackable Implementation Actions of Responsible Dischargers

Implementing Party	Sources	Regulatory Mechanism(s)	Actions of Implementing Party	Schedule of Action(s)
City of Santa Cruz	Sewage Spills and Leaks	Existing NPDES permit. Water Board Executive	1. CSMP: Collection System Management Plan to include specific actions that have been and/or will be taken to reduce fecal coliform loading from sewage spills and leaks. The City will address inspection, maintenance and repairs of the collection system within one-hundred feet of San Lorenzo River waters within the City's jurisdiction 2. Annual Report: Report specific measures that have and/or will be taken to reduce fecal coliform loading.	Submit Annual Report within one year after TMDL adoption by Regional Water Board and annually every year thereafter until numeric target achieved.
	Sewage Spills and Leaks	Existing NPDES permit. Water Board Executive	1. CSMP: Collection System Management Plan to include specific actions that have been and/or will be taken to reduce fecal coliform loading from sewage spills and leaks. The City will address inspection, maintenance and repairs of the entire collection system within the San Lorenzo River watershed within the City's jurisdiction 2. Annual Report: Report specific measures that have and/or will be taken to reduce fecal coliform loading. The Report will provide demonstration that fecal coliform discharges from the collection system have ceased.	Submit Annual Report within five years after Regional Water Board adoption and annually every year thereafter until numeric target achieved.

Implementing Party	Sources	Regulatory Mechanism(s)	Actions of Implementing Party	Schedule of Action(s)
	Storm Drain Discharges	Anticipated Small MS4 Permit	1. SWMP: Adopt Storm Water Management Plan to include specific actions (including, addressing private lateral spills, urban runoff, pet wastes, dumpster leachate, and controllable rodent, bird, and wildlife waste and including public education) that have been and/or will be taken to reduce fecal coliform loading from urban sources. These actions include measures mentioned in the "Storm Water Management Plan/Program Requirements" section of this document. 2. Annual Report: Report specific measures that have and/or will be taken to reduce fecal coliform loading from urban sources. The Report will provide demonstration that fecal coliform concentrations from the storm drain have ceased.	Within one year after TMDL adoption by the Regional Water Board.

Implementing Party	Sources	Regulatory Mechanism(s)	Actions of Implementing Party	Schedule of Action(s)
City of Scotts Valley	Storm Drain Discharges	Anticipated Small MS4 Permit	1. SWMP: Adopt Storm Water Management Plan to include specific actions (including, addressing private lateral spills, urban runoff, pet wastes, dumpster leachate, and controllable rodent, bird, and wildlife waste and including public education) that have been and/or will be taken to reduce fecal coliform loading from urban sources. These actions include measures mentioned in the "Storm Water Management Plan/Program Requirements" section of this document. 2. Annual Report: Report specific measures that have and/or will be taken to reduce fecal coliform loading from urban sources. The Report will provide demonstration that fecal coliform concentrations from the storm drain have ceased.	Within one year after TMDL adoption by the Regional Water Board.
Santa Cruz County	Storm Drain Discharges	Anticipated Small MS4 Permit	1. SWMP: Adopt Storm Water Management Plan to include specific actions (including, addressing urban runoff, pet wastes, dumpster leachate, and controllable rodent, bird, and wildlife waste and including public education) that have been and/or will be taken to reduce fecal coliform loading from urban sources. These actions include measures mentioned in the "Storm Water Management Plan/Program Requirements" section of this document. 2. Annual Report: Report specific measures that have and/or will be taken to reduce fecal coliform loading from urban sources. The Report will provide demonstration that fecal coliform concentrations from the storm drain have ceased.	Within one year after TMDL adoption by the Regional Water Board.

Implementing Party	Sources	Regulatory Mechanism(s)	Actions of Implementing Party	Schedule of Action(s)
City of Santa Cruz	Illegal Recreational Vehicle Discharge	Anticipated Plan to Conform with Existing Basin Plan Waste Discharge Prohibition	1. Prohibition Attainment Plan: Develop and implement strategies to reduce/eliminate fecal coliform loading from illegal recreational vehicle discharges into surface waters of the San Lorenzo River Watershed. Submit Plan to the Executive Officer of the Water Board and monitor and report, or, document and report to the Water Board that no discharge is occurring from recreational vehicles. 2. Annual Report: Report specific measures that have and/or will be taken to reduce fecal coliform loading from illegal recreational vehicle discharges. The Report will provide demonstration that fecal coliform concentrations from recreational vehicles have ceased.	Within one year after TMDL adoption by the Regional Water Board.
Santa Cruz County	Homeless Encampments	Anticipated Plan to Conform with Existing Basin Plan Waste Discharge Prohibition	1. Prohibition Attainment Plan: Develop and implement strategies to reduce/eliminate fecal coliform loading from homeless encampments into surface waters of the San Lorenzo River Watershed. Submit Plan to the Executive Officer of the Water Board and monitor and report, or, document and report to the Water Board that no discharge is occurring from recreational vehicles. 2. Annual Report: Report specific measures that have and/or will be taken to reduce fecal coliform loading from illegal recreational vehicle discharges. The Report will provide demonstration that fecal coliform concentrations from recreational vehicles have ceased.	Within one year after TMDL adoption by the Regional Water Board.

Implementing Party	Sources	Regulatory Mechanism(s)	Actions of Implementing Party	Schedule of Action(s)
Operators or owners of livestock facilities and animals	Livestock	Farm Animal and Livestock Facilities Management	1. Prohibition Attainment Plan: Develop and implement strategies to reduce/eliminate fecal coliform loading from farm animal and livestock facilities (e.g., pens, corrals, barns) into surface waters of the San Lorenzo Estuary, Branciforte Creek, and Carbonera Creek Watersheds. Submit Nonpoint Source Control Implementation Program to the Executive Officer of the Water Board and monitor and report, or, document and report to the Water Board that no discharge is occurring from animal facilities.	

10.5. Evaluation of Implementation Progress

Water Board staff will conduct a review of implementation every three years beginning three years after the Water Board approves the TMDL. Water Board staff will use annual reports, NPS Pollution Control Implementation Programs, as well as other available information, to review water quality data and implementation efforts as well as overall progress towards achieving the allocations and the numeric target.

Regional Water Board staff may conclude that ongoing implementation efforts are insufficient to ultimately achieve the allocations and numeric target. If staff were to make this determination, staff would recommend that additional reporting, monitoring, or implementation efforts be required either through approval by the Executive Officer (e.g. pursuant to Section 13267 or Section 13383 of the California Water Code) or by the Water Board (e.g. through revisions of existing permits and/or a Basin Plan Amendment). Staff may conclude that at the time of review, they expect implementation efforts to result in achieving the allocations and numeric target. In that case, existing and anticipated implementation efforts should continue. Three-year reviews will continue until the TMDL is achieved.

Responsible parties will monitor according to the proposed monitoring plan (see Chapter 11) for at least three years, at which time Regional Water Board staff will determine the need for continuing or otherwise modifying the monitoring requirements. If it were demonstrated that controllable sources of pathogens are not contributing to exceedance of water quality objectives in receiving waters, staff would consider modifying numeric targets and/or allocations. This may result, for example, in staff establishing a site-specific objective for San Lorenzo River Estuary, Branciforte Creek, and Carbonera Creek. The site-specific objective would be based on evidence that natural, or "background" sources alone were the cause of exceedances of the Basin Plan water quality objective for fecal coliform.

10.6. Timeline and Milestones

It is anticipated that the allocations, and therefore TMDL, will be achieved ten years from the date of approval of the TMDL. The estimation is based on the cost and difficulty inherent in identifying fecal coliform sources from all sources. The estimation is also based on the uncertainty of the time required for water quality improvement resulting from best management practices to be realized. Small MS4 permits outline a 5-year schedule for full implementation of best management practices (BMPs) and activities. In general, stormwater BMPs are designed to achieve compliance with water quality standards to the maximum extent practicable through an iterative process. It is anticipated that the full in-stream positive effect of the BMPs will be realized gradually, and after full implementation of the BMPs. Staff therefore set a goal for TMDL attainment of ten years after TMDL adoption. In addition, stormwater permits may include additional provisions that the Water Board determines are necessary to control pollutants. (CWA section 402(p)(3)(B)(iii).) The Water Board can consider additional

requirements if BMP implementation does not result in adequate water quality improvement.

11. MONITORING PLAN

11.1. Introduction

The Monitoring Plan outlines the monitoring sites, frequency of monitoring, and parties responsible for monitoring. The monitoring proposed below for TMDL compliance and evaluation is the minimum staff believes is necessary. However, if a change in these requirements is warranted after the TMDL is approved, the Executive Officer and/or the Water Board will require such changes.

11.2. Monitoring Sites, Frequency, and Responsible Parties

Fecal coliform monitoring is necessary for receiving waters at the following stations:

- San Lorenzo River Lagoon @ Trestle
- San Lorenzo River Lagoon @ Broadway/Laurel Bridge
- San Lorenzo River @ Soquel Avenue Bridge
- San Lorenzo River @ Sycamore Grove
- Branciforte Creek @ San Lorenzo River
- Branciforte Creek @ Carbonera Creek
- Carbonera Creek @ Branciforte Creek

Storm Drain Sampling is also necessary at the following stations:

-
- Mott Street storm drain
- Gravity storm drain at Trestle
- Jessie Street storm drain
- Laurel Street Exit at San Lorenzo River Estuary storm drain
- Riverside West storm drain
- Broadway storm drain
- West Water Street storm drain
- Raymond Street at San Lorenzo River storm drain
- Northeast Bixby at San Lorenzo Blvd storm drain
-

Table xx below identifies the responsible party, monitoring site, sampling period, number of samples, and constituent.

Table 15. Fecal Coliform Monitoring Required

Responsible Party	Monitoring Site	Sampling Period	Number of Samples	Constituent (#/100 mL)
RECEIVING WATER MONITORING				
Santa Cruz County Environmental Health	San Lorenzo River Lagoon @ Trestle	Jan- Mar	5[1]	Fecal Coliform
		April-May	5[1]	Fecal Coliform
		June-Sept	5[1]	Fecal Coliform
		Oct-Dec	5[1]	Fecal Coliform
	San Lorenzo River Lagoon @ Broadway/Laurel Bridge	Jan-Mar	5[1]	Fecal Coliform
		April-May	5[1]	Fecal Coliform
		June-Sept	5[1]	Fecal Coliform
		Oct-Dec	5[1]	Fecal Coliform
	San Lorenzo River @ Soquel Avenue Bridge	Jan-Mar	5[1]	Fecal Coliform
		April-May	5[1]	Fecal Coliform
		June-Sept	5[1]	Fecal Coliform
		Oct-Dec	5[1]	Fecal Coliform
	San Lorenzo River @ Sycamore Grove	Jan-Mar	5[1]	Fecal Coliform
		April-May	5[1]	Fecal Coliform
		June-Sept	5[1]	Fecal Coliform
		Oct-Dec	5[1]	Fecal Coliform
	Branciforte Creek @ San Lorenzo River	Jan-Mar	5[1]	Fecal Coliform
		April-May	5[1]	Fecal Coliform
		June-Sept	5[1]	Fecal Coliform
		Oct-Dec	5[1]	Fecal Coliform
	Branciforte Creek @ Carbonera Creek	Jan-Dec	12[2]	Fecal Coliform
	Carbonera Creek @ Branciforte Creek	Jan-Dec	12[2]	Fecal Coliform
City of Scotts Valley	Sampling Sites will be determined by the City and the County and approved by the Executive Officer of the Central Coast Water Board if the Executive Officer determines Carbonera Creek is impaired.	Quarterly	5[1]	Fecal Coliform
STORM WATER MONITORING				

Responsible Party	Monitoring Site	Sampling Period	Number of Samples	Constituent (#/100 mL)
City of Santa Cruz	Sampling Sites will be determined by the City and the County and approved by the Executive Officer of the Central Coast Water Board	Quarterly	5[1]	Fecal Coliform
City of Scotts Valley	Sampling Sites will be determined by the City and the County and approved by the Executive Officer of the Central Coast Water Board	Quarterly	5[1]	Fecal Coliform
RIBOTYPING MONITORING				
Santa Cruz County	San Lorenzo River @ Trestle	Every Three Years following adoption of this TMDL by the Central Coast Water Board	??????	???????????
	Carbonera Creek upstream of the confluence with Branciforte Creek	Every Three Years following adoption of this TMDL by the Central Coast Water Board	??????	???????????

[1] Five samples must be drawn in a 30-day period within each sampling period
[2] One sample must be drawn in a 30-day period within the sampling period

Table xx identifies the responsible party, monitoring site, sampling period, number of samples, and constituent

11.3. Reporting

Santa Cruz County Environmental Health will incorporate monitoring results into the annual reports described in Table 10.1 of the Implementation plan.

If reporting changes become necessary based on staff's assessment of the TMDL implementation progress, the Executive Officer or the Water Board will require such changes.

REFERENCES

California Regional Water Quality Control Board, Central Coast Region *Water Quality Control Plan, Central Coast Region,* September 8, 1994 (amended April 14, 1995)

California Regional Water Board *San Lorenzo River Pathogen Project Plan*, June 1, 2004

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Santa Cruz County Health Services Agency, Environmental Health Services, *San Lorenzo River Watershed Management Plan Update, Evaluation of Water Quality Issues and Proposed Investigations, Task 4.1 Report,* undated

Santa Cruz County Planning Department, *The San Lorenzo River Watershed Management Plan*, December 1979

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Santa Cruz County, Health Services Agency, Environmental Health Services, *San Lorenzo Wastewater Management Plan Program Status Report*, 1999-2001

Santa Cruz Sentinel, *Homeless Camp Cleared*, October 22, 2005

State Water Resources Control Board, 2004a. Policy for implementation and Enforcement of the Nonpoint Source Pollution Control Program (and Fact Sheet). May 20. (Adopted August 26, 2004).

United States Environmental Protection Agency, *Protocol for Developing Pathogen TMDLs*, January 2001

APPENDIX ONE: FECAL COLIFORM AND *E. COLI* SAMPLING RESULTS

San Lorenzo River Data

San Lorenzo River Mouth @ Trestle	Fecal Coliform (#/100 mL)	San Lorenzo River @ Broadway/ Laurel St Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Soquel Av Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Sycamore Grove	Fecal Coliform (#/100 mL)
04-Jan-00	20	04-Jan-00	0.9	24-Nov-86	200	04-Jan-00	36
11-Jan-00	320	11-Jan-00	520	20-May-87	4900	11-Jan-00	50
20-Jan-00	780	20-Jan-00	640	08-Nov-88	1850	20-Jan-00	460
26-Jan-00	340	26-Jan-00	220	30-Nov-88	400	26-Jan-00	320
01-Feb-00	580	01-Feb-00	280	07-Dec-88	1010	01-Feb-00	260
09-Feb-00	420	09-Feb-00	2520	31-Jan-89	1660	02-Feb-00	260
16-Feb-00	660	16-Feb-00	820	18-Apr-89	720	09-Feb-00	60
24-Feb-00	120	24-Feb-00	60	23-Aug-89	26400	16-Feb-00	210
01-Mar-00	160	01-Mar-00	140	26-Jun-91	420	24-Feb-00	100
08-Mar-00	2000	08-Mar-00	1900	02-Jul-91	125	01-Mar-00	90
15-Mar-00	580	15-Mar-00	80	05-Feb-92	392	08-Mar-00	1650
22-Mar-00	80	22-Mar-00	200	05-May-93	604	15-Mar-00	90
29-Mar-00	100	29-Mar-00	160	21-Aug-95	76	22-Mar-00	50
05-Apr-00	280	05-Apr-00	160	23-Aug-95	156	29-Mar-00	10
12-Apr-00	130	12-Apr-00	250	05-Dec-95	240	05-Apr-00	20
13-Apr-00	324	19-Apr-00	180	18-Dec-95	3620	12-Apr-00	20
19-Apr-00	170	26-Apr-00	390	03-Jan-96	550	19-Apr-00	110
26-Apr-00	80	03-May-00	160	17-Jan-96	1600	25-Apr-00	60
03-May-00	120	11-May-00	160	30-Jan-96	500	26-Apr-00	88
11-May-00	150	17-May-00	250	15-Feb-96	420	03-May-00	60
17-May-00	450	24-May-00	1060	29-Feb-96	0.9	11-May-00	120
24-May-00	210	01-Jun-00	650	29-May-96	100	17-May-00	90
01-Jun-00	310	08-Jun-00	1250	11-Jun-96	240	24-May-00	180
08-Jun-00	3350	14-Jun-00	340	26-Jun-96	420	25-May-00	180
14-Jun-00	740	22-Jun-00	200	09-Jul-96	168	01-Jun-00	100
22-Jun-00	320	28-Jun-00	270	21-Aug-96	3030	08-Jun-00	210
28-Jun-00	830	06-Jul-00	50	23-Sep-96	370	14-Jun-00	100
06-Jul-00	120	13-Jul-00	220	07-Oct-96	120	20-Jun-00	4
13-Jul-00	60	27-Jul-00	160	23-Oct-96	300	22-Jun-00	20
19-Jul-00	120	02-Aug-00	370	29-Oct-96	13300	28-Jun-00	50
27-Jul-00	110	08-Aug-00	320	07-Nov-96	290	06-Jul-00	30
02-Aug-00	440	17-Aug-00	408	26-Nov-96	490	11-Jul-00	36
09-Aug-00	120	30-Aug-00	420	18-Dec-96	360	19-Jul-00	16
17-Aug-00	360	07-Sep-00	312	06-Jan-97	100	20-Jul-00	2
24-Aug-00	250	12-Sep-00	280	03-Feb-97	150	25-Jul-00	64
30-Aug-00	200	28-Sep-00	160			01-Aug-00	44
07-Sep-00	3336	12-Oct-00	200			09-Aug-00	76

San Lorenzo River Mouth @ Trestle	Fecal Coliform (#/100 mL)	San Lorenzo River @ Broadway/ Laurel St Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Soquel Av Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Sycamore Grove	Fecal Coliform (#/100 mL)
12-Sep-00	2480	17-Oct-00	96			16-Aug-00	24
19-Sep-00	2928	24-Oct-00	3300			24-Aug-00	20
28-Sep-00	50	01-Nov-00	400			30-Aug-00	64
03-Oct-00	1252	08-Nov-00	570			07-Sep-00	32
12-Oct-00	60	14-Nov-00	2			11-Sep-00	40
17-Oct-00	52	20-Nov-00	180			17-Sep-00	92
24-Oct-00	52	29-Nov-00	1940			28-Sep-00	30
01-Nov-00	170	06-Dec-00	124			03-Oct-00	22
06-Nov-00	100	11-Dec-00	312			05-Oct-00	8
14-Nov-00	2	20-Dec-00	712			12-Oct-00	20
20-Nov-00	5	26-Dec-00	4			17-Oct-00	40
29-Nov-00	610	09-Jan-01	410			24-Oct-00	50
06-Dec-00	72	16-Jan-01	116			01-Nov-00	130
11-Dec-00	148	17-Jan-01	100			08-Nov-00	40
20-Dec-00	28	29-Jan-01	430			14-Nov-00	2
26-Dec-00	4	06-Feb-01	344			20-Nov-00	10
04-Jan-01	12	14-Feb-01	1145			28-Nov-00	310
09-Jan-01	220	21-Feb-01	2928			06-Dec-00	4
16-Jan-01	44	26-Feb-01	400			11-Dec-00	12
22-Jan-01	20	07-Mar-01	130			19-Dec-00	2
29-Jan-01	100	12-Mar-01	100			26-Dec-00	8
06-Feb-01	2976	19-Mar-01	290			04-Jan-01	12
14-Feb-01	262	26-Mar-01	390			09-Jan-01	472
21-Feb-01	336	02-Apr-01	60			16-Jan-01	36
26-Feb-01	210	09-Apr-01	230			22-Jan-01	12
07-Mar-01	110	16-Apr-01	30			29-Jan-01	20
12-Mar-01	50	24-Apr-01	90			05-Feb-01	12
19-Mar-01	100	30-Apr-01	120			15-Feb-01	146
27-Mar-01	590	07-May-01	200			21-Feb-01	340
02-Apr-01	400	14-May-01	320			26-Feb-01	110
09-Apr-01	550	21-May-01	310			07-Mar-01	210
16-Apr-01	5	29-May-01	20			12-Mar-01	100
24-Apr-01	210	06-Jun-01	780			19-Mar-01	110
30-Apr-01	20	11-Jun-01	320			26-Mar-01	380
07-May-01	190	18-Jun-01	260			29-Mar-01	50
14-May-01	80	25-Jun-01	810			02-Apr-01	80
21-May-01	2400	02-Jul-01	3970			09-Apr-01	100
29-May-01	16	09-Jul-01	500			16-Apr-01	20
06-Jun-01	100	16-Jul-01	1060			24-Apr-01	60
11-Jun-01	556	23-Jul-01	570			30-Apr-01	110
18-Jun-01	80	31-Jul-01	580			07-May-01	10
25-Jun-01	490	06-Aug-01	1890			14-May-01	60
02-Jul-01	400	14-Aug-01	570			21-May-01	130

San Lorenzo River Mouth @ Trestle	Fecal Coliform (#/100 mL)	San Lorenzo River @ Broadway/ Laurel St Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Soquel Av Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Sycamore Grove	Fecal Coliform (#/100 mL)
09-Jul-01	5600	20-Aug-01	1400			23-May-01	20
16-Jul-01	8040	28-Aug-01	310			29-May-01	30
23-Jul-01	90	05-Sep-01	380			06-Jun-01	40
31-Jul-01	60	10-Sep-01	576			11-Jun-01	32
07-Aug-01	170	18-Sep-01	530			18-Jun-01	50
14-Aug-01	3910	24-Sep-01	290			20-Jun-01	8
20-Aug-01	1870	01-Oct-01	450			25-Jun-01	20
28-Aug-01	380	10-Oct-01	760			02-Jul-01	48
05-Sep-01	1670	15-Oct-01	620			09-Jul-01	20
07-Sep-01	280	22-Oct-01	850			16-Jul-01	112
10-Sep-01	16632	29-Oct-01	1010			23-Jul-01	70
18-Sep-01	1210	05-Nov-01	520			31-Jul-01	20
24-Sep-01	110	15-Nov-01	1760			07-Aug-01	120
01-Oct-01	680	19-Nov-01	1210			14-Aug-01	88
10-Oct-01	7420	26-Nov-01	970			20-Aug-01	90
15-Oct-01	1090	03-Dec-01	680			28-Aug-01	70
22-Oct-01	400	10-Dec-01	420			05-Sep-01	60
29-Oct-01	1200	17-Dec-01	4150			10-Sep-01	96
05-Nov-01	2780	26-Dec-01	310			17-Sep-01	30
15-Nov-01	1500	03-Jan-02	620			24-Sep-01	36
19-Nov-01	1180	07-Jan-02	130			27-Sep-01	8
26-Nov-01	1230	14-Jan-02	60			01-Oct-01	40
03-Dec-01	20	24-Jan-02	100			10-Oct-01	52
10-Dec-01	510	28-Jan-02	170			15-Oct-01	40
17-Dec-01	2520	04-Feb-02	10			22-Oct-01	28
26-Dec-01	220	11-Feb-02	50			29-Oct-01	110
03-Jan-02	860	19-Feb-02	400			5-Nov-01	64
07-Jan-02	160	25-Feb-02	20			15-Nov-01	730
24-Jan-02	130	05-Mar-02	80			19-Nov-01	120
28-Jan-02	10	11-Mar-02	90			26-Nov-01	480
04-Feb-02	5	18-Mar-02	90			29-Nov-01	5000
11-Feb-02	20	25-Mar-02	60			3-Dec-01	500
12-Feb-02	20	03-Apr-02	60			10-Dec-01	180
19-Feb-02	280	08-Apr-02	230			17-Dec-01	270
25-Feb-02	50	15-Apr-02	1140			19-Dec-01	70
26-Feb-02	160	29-Apr-02	120			26-Dec-01	76
05-Mar-02	100	07-May-02	30			3-Jan-02	150
11-Mar-02	110	13-May-02	140			7-Jan-02	150
18-Mar-02	130	20-May-02	590			9-Jan-02	50
25-Mar-02	220	28-May-02	80			14-Jan-02	50
03-Apr-02	110	03-Jun-02	60			22-Jan-02	40
08-Apr-02	640	18-Jun-02	170			28-Jan-02	30
15-Apr-02	1150	26-Jun-02	490			4-Feb-02	5

San Lorenzo River Mouth @ Trestle	Fecal Coliform (#/100 mL)	San Lorenzo River @ Broadway/ Laurel St Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Soquel Av Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Sycamore Grove	Fecal Coliform (#/100 mL)
24-Apr-02	50	02-Jul-02	40			11-Feb-02	30
29-Apr-02	200	09-Jul-02	350			13-Feb-02	4
07-May-02	4170	16-Jul-02	50			19-Feb-02	160
13-May-02	100	23-Jul-02	180			25-Feb-02	5
20-May-02	400	30-Jul-02	120			5-Mar-02	20
21-May-02	940	06-Aug-02	240			11-Mar-02	110
28-May-02	140	13-Aug-02	660			18-Mar-02	210
03-Jun-02	90	20-Aug-02	120			19-Mar-02	10
11-Jun-02	10	27-Aug-02	210			25-Mar-02	50
18-Jun-02	80	04-Sep-02	470			3-Apr-02	20
26-Jun-02	20	10-Sep-02	1350			8-Apr-02	50
02-Jul-02	230	19-Sep-02	140			15-Apr-02	60
09-Jul-02	60	23-Sep-02	169			18-Apr-02	32
23-Jul-02	10	02-Oct-02	490			24-Apr-02	8
30-Jul-02	630	07-Oct-02	124			29-Apr-02	150
06-Aug-02	60	15-Oct-02	110			7-May-02	10
13-Aug-02	60	23-Oct-02	1860			13-May-02	40
20-Aug-02	5	30-Oct-02	570			20-May-02	108
27-Aug-02	130	04-Nov-02	150			28-May-02	40
04-Sep-02	170	12-Nov-02	250			3-Jun-02	32
10-Sep-02	100	18-Nov-02	200			10-Jun-02	34
19-Sep-02	80	25-Nov-02	510			18-Jun-02	80
25-Sep-02	248	03-Dec-02	920			26-Jun-02	60
01-Oct-02	190	10-Dec-02	470			2-Jul-02	36
07-Oct-02	1116	17-Dec-02	470			9-Jul-02	56
15-Oct-02	90	23-Dec-02	240			16-Jul-02	40
23-Oct-02	610	30-Dec-02	160			23-Jul-02	40
30-Oct-02	950	07-Jan-03	130			30-Jul-02	5
04-Nov-02	350	13-Jan-03	100			31-Jul-02	10
12-Nov-02	370	21-Jan-03	76			6-Aug-02	32
18-Nov-02	230	26-Jan-03	150			13-Aug-02	24
25-Nov-02	270	28-Jan-03	190			20-Aug-02	28
03-Dec-02	1200	04-Feb-03	70			27-Aug-02	10
10-Dec-02	480	10-Feb-03	20			29-Aug-02	50
17-Dec-02	630	18-Feb-03	90			4-Sep-02	60
18-Dec-02	260	27-Feb-03	640			10-Sep-02	28
23-Dec-02	30	05-Mar-03	280			19-Sep-02	20
30-Dec-02	380	13-Mar-03	20			25-Sep-02	16
07-Jan-03	190	17-Mar-03	320			25-Sep-02	16
13-Jan-03	300	25-Mar-03	20			1-Oct-02	20
21-Jan-03	1200	01-Apr-03	330			7-Oct-02	44
26-Jan-03	50	08-Apr-03	270			8-Oct-02	20
28-Jan-03	180	15-Apr-03	510			16-Oct-02	30

San Lorenzo River Mouth @ Trestle	Fecal Coliform (#/100 mL)	San Lorenzo River @ Broadway/ Laurel St Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Soquel Av Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Sycamore Grove	Fecal Coliform (#/100 mL)
04-Feb-03	220	23-Apr-03	130			23-Oct-02	64
10-Feb-03	20	28-Apr-03	800			30-Oct-02	70
18-Feb-03	140	05-May-03	90			4-Nov-02	50
27-Feb-03	720	13-May-03	40			12-Nov-02	280
05-Mar-03	310	20-May-03	50			14-Nov-02	150
13-Mar-03	30	27-May-03	220			18-Nov-02	150
17-Mar-03	1190	03-Jun-03	500			25-Nov-02	16
25-Mar-03	50	11-Jun-03	340			3-Dec-02	80
01-Apr-03	550	18-Jun-03	370			10-Dec-02	120
08-Apr-03	80	23-Jun-03	264			17-Dec-02	160
15-Apr-03	480	01-Jul-03	30			23-Dec-02	90
23-Apr-03	100	07-Jul-03	50			30-Dec-02	90
28-Apr-03	530	14-Jul-03	340			7-Jan-03	250
05-May-03	170	21-Jul-03	140			13-Jan-03	136
13-May-03	170	29-Jul-03	244			15-Jan-03	330
20-May-03	40	04-Aug-03	80			21-Jan-03	96
27-May-03	700	11-Aug-03	300			28-Jan-03	44
03-Jun-03	280	19-Aug-03	1868			4-Feb-03	130
11-Jun-03	240	26-Aug-03	540			10-Feb-03	20
18-Jun-03	310	02-Sep-03	830			11-Feb-03	10
23-Jun-03	272	08-Sep-03	470			18-Feb-03	76
01-Jul-03	180	15-Sep-03	1530			27-Feb-03	160
07-Jul-03	140	23-Sep-03	1020			5-Mar-03	260
14-Jul-03	180	29-Sep-03	135			13-Mar-03	60
21-Jul-03	126	06-Oct-03	470			17-Mar-03	70
29-Jul-03	400	14-Oct-03	160			19-Mar-03	200
04-Aug-03	56	20-Oct-03	750			25-Mar-03	80
11-Aug-03	988	27-Oct-03	640			1-Apr-03	96
19-Aug-03	1324	04-Nov-03	500			7-Apr-03	40
26-Aug-03	1220	12-Nov-03	430			8-Apr-03	40
02-Sep-03	800	17-Nov-03	410			15-Apr-03	230
08-Sep-03	400	24-Nov-03	1200			23-Apr-03	130
15-Sep-03	1010	01-Dec-03	3280			28-Apr-03	560
23-Sep-03	710	09-Dec-03	320			5-May-03	80
29-Sep-03	416	15-Dec-03	200			13-May-03	48
06-Oct-03	580	22-Dec-03	260			20-May-03	20
14-Oct-03	10	31-Dec-03	140			27-May-03	52
20-Oct-03	840	05-Jan-04	170			29-May-03	96
21-Oct-03	240	12-Jan-04	220			3-Jun-03	170
27-Oct-03	3100	20-Jan-04	60			11-Jun-03	370
28-Oct-03	900	02-Feb-04	350			18-Jun-03	170
04-Nov-03	640	17-Feb-04	1330			23-Jun-03	32
05-Nov-03	260	23-Feb-04	60			30-Jun-03	16

San Lorenzo River Mouth @ Trestle	Fecal Coliform (#/100 mL)	San Lorenzo River @ Broadway/ Laurel St Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Soquel Av Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Sycamore Grove	Fecal Coliform (#/100 mL)
12-Nov-03	290	01-Mar-04	420			1-Jul-03	20
17-Nov-03	380	08-Mar-04	10			7-Jul-03	5
24-Nov-03	490	15-Mar-04	260			14-Jul-03	60
01-Dec-03	5760	22-Mar-04	50			15-Jul-03	120
08-Dec-03	820	29-Mar-04	180			21-Jul-03	52
09-Dec-03	330	06-Apr-04	80			29-Jul-03	32
15-Dec-03	260	12-Apr-04	160			4-Aug-03	60
22-Dec-03	410	19-Apr-04	230			11-Aug-03	52
31-Dec-03	420	26-Apr-04	190			19-Aug-03	52
05-Jan-04	100	03-May-04	100			26-Aug-03	150
12-Jan-04	160	10-May-04	190			2-Sep-03	170
20-Jan-04	20	17-May-04	190			8-Sep-03	160
21-Jan-04	50	26-May-04	580			15-Sep-03	200
02-Feb-04	70	01-Jun-04	260			23-Sep-03	160
09-Feb-04	120	09-Jun-04	430			23-Sep-03	220
17-Feb-04	1180	15-Jun-04	85			29-Sep-03	60
23-Feb-04	50	21-Jun-04	100			6-Oct-03	100
01-Mar-04	440	29-Jun-04	310			10-Oct-03	96
08-Mar-04	10	07-Jul-04	1330			14-Oct-03	70
15-Mar-04	170	12-Jul-04	690			20-Oct-03	110
22-Mar-04	80	19-Jul-04	650			27-Oct-03	30
23-Mar-04	300	29-Jul-04	304			4-Nov-03	180
29-Mar-04	80	04-Aug-04	100			12-Nov-03	40
06-Apr-04	50	09-Aug-04	216			17-Nov-03	120
12-Apr-04	140	16-Aug-04	3580			24-Nov-03	10
19-Apr-04	200	23-Aug-04	920			1-Dec-03	1430
26-Apr-04	70	30-Aug-04	130			8-Dec-03	230
03-May-04	80	08-Sep-04	130			9-Dec-03	90
10-May-04	30	13-Sep-04	130			15-Dec-03	610
17-May-04	290	20-Sep-04	470			22-Dec-03	220
26-May-04	240	27-Sep-04	200			30-Dec-03	250
01-Jun-04	200	04-Oct-04	360			5-Jan-04	150
09-Jun-04	270	13-Oct-04	50			7-Jan-04	40
15-Jun-04	190	18-Oct-04	2000			12-Jan-04	110
16-Jun-04	620	27-Oct-04	780			20-Jan-04	80
21-Jun-04	340	01-Nov-04	310			26-Jan-04	50
24-Jun-04	240	08-Nov-04	1280			02-Feb-04	160
29-Jun-04	180	15-Nov-04	470			09-Feb-04	50
07-Jul-04	600	22-Nov-04	70			11-Feb-04	100
12-Jul-04	120	01-Dec-04	70			17-Feb-04	500
19-Jul-04	290	06-Dec-04	90			23-Feb-04	50
20-Jul-04	210	13-Dec-04	300			01-Mar-04	100
29-Jul-04	260	21-Dec-04	200			02-Mar-04	80

San Lorenzo River Mouth @ Trestle	Fecal Coliform (#/100 mL)	San Lorenzo River @ Broadway/ Laurel St Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Soquel Av Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Sycamore Grove	Fecal Coliform (#/100 mL)
02-Aug-04	160	28-Dec-04	1000			08-Mar-04	20
04-Aug-04	170	05-Jan-05	230			15-Mar-04	20
09-Aug-04	232	10-Jan-05	1430			22-Mar-04	190
16-Aug-04	30	19-Jan-05	40			29-Mar-04	60
18-Aug-04	180	24-Jan-05	90			06-Apr-04	10
23-Aug-04	1050	31-Jan-05	150			12-Apr-04	40
30-Aug-04	40	07-Feb-05	4000			19-Apr-04	130
08-Sep-04	190	14-Feb-05	90			26-Apr-04	30
13-Sep-04	30	21-Feb-05	630			03-May-04	70
20-Sep-04	160	28-Feb-05	2240			10-May-04	20
21-Sep-04	176	7-Mar-05	150			10-May-04	30
27-Sep-04	50	15-Mar-05	130			17-May-04	110
04-Oct-04	84	21-Mar-05	500			26-May-04	40
13-Oct-04	80	28-Mar-05	2020			01-Jun-04	80
18-Oct-04	2000	4-Apr-05	720			09-Jun-04	50
27-Oct-04	736	11-Apr-05	260			14-Jun-04	48
01-Nov-04	270	18-Apr-05	262			15-Jun-04	50
08-Nov-04	1630	25-Apr-05	150			21-Jun-04	24
15-Nov-04	370	2-May-05	150			29-Jun-04	40
22-Nov-04	30	9-May-05	470			07-Jul-04	40
01-Dec-04	30	16-May-05	231			12-Jul-04	24
06-Dec-04	20	23-May-05	130			14-Jul-04	30
13-Dec-04	200	1-Jun-05	320			19-Jul-04	72
21-Dec-04	40	6-Jun-05	370			20-Jul-04	44
28-Dec-04	880	13-Jun-05	80			29-Jul-04	16
05-Jan-05	170	23-Jun-05	270			04-Aug-04	72
10-Jan-05	200	29-Jun-05	1250			04-Aug-04	80
19-Jan-05	120	5-Jul-05	160			09-Aug-04	40
24-Jan-05	290	11-Jul-05	50			11-Aug-04	40
31-Jan-05	150	18-Jul-05	340			16-Aug-04	36
07-Feb-05	90	25-Jul-05	70			23-Aug-04	36
14-Feb-05	100	1-Aug-05	60			30-Aug-04	40
21-Feb-05	2190	8-Aug-05	3430			02-Sep-04	30
28-Feb-05	1610	15-Aug-05	250			08-Sep-04	124
7-Mar-05	230	22-Aug-05	280			13-Sep-04	20
15-Mar-05	60	30-Aug-05	4900			20-Sep-04	76
21-Mar-05	490	6-Sep-05	552			27-Sep-04	44
28-Mar-05	2180	15-Sep-05	440			04-Oct-04	40
4-Apr-05	390	19-Sep-05	590			06-Oct-04	60
11-Apr-05	110	26-Sep-05	180			13-Oct-04	36
18-Apr-05	160	3-Oct-05	180			18-Oct-04	2000
25-Apr-05	60	12-Oct-05	100			27-Oct-04	1520
2-May-05	40	18-Oct-05	290			01-Nov-04	100

San Lorenzo River Mouth @ Trestle	Fecal Coliform (#/100 mL)	San Lorenzo River @ Broadway/ Laurel St Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Soquel Av Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Sycamore Grove	Fecal Coliform (#/100 mL)
9-May-05	420	25-Oct-05	260			03-Nov-04	75
16-May-05	128	1-Nov-05	150			08-Nov-04	32
23-May-05	230	9-Nov-05	550			15-Nov-04	72
1-Jun-05	340	16-Nov-05	240			22-Nov-04	32
6-Jun-05	570	22-Nov-05	28			01-Dec-04	32
13-Jun-05	80	30-Nov-05	850			06-Dec-04	20
23-Jun-05	390	5-Dec-05	380			08-Dec-04	150
29-Jun-05	420	14-Dec-05	190			13-Dec-04	68
5-Jul-05	80	19-Dec-05	1800			21-Dec-04	48
11-Jul-05	70	27-Dec-05	280			28-Dec-04	290
18-Jul-05	130	3-Jan-06	280			05-Jan-05	88
25-Jul-05	5	10-Jan-06	330			10-Jan-05	64
1-Aug-05	30	17-Jan-06	180			19-Jan-05	36
8-Aug-05	350	23-Jan-06	40			20-Jan-05	55
15-Aug-05	100					24-Jan-05	60
22-Aug-05	5					31-Jan-05	76
30-Aug-05	990					03-Feb-05	40
6-Sep-05	992					07-Feb-05	80
15-Sep-05	70					14-Feb-05	36
26-Sep-05	300					21-Feb-05	800
3-Oct-05	220					28-Feb-05	2140
12-Oct-05	40					7-Mar-05	84
18-Oct-05	70					9-Mar-05	112
19-Oct-05	250					15-Mar-05	72
25-Oct-05	170					21-Mar-05	260
1-Nov-05	340					28-Mar-05	2070
9-Nov-05	1180					4-Apr-05	470
16-Nov-05	70					11-Apr-05	76
22-Nov-05	60					18-Apr-05	100
30-Nov-05	1430					25-Apr-05	84
5-Dec-05	220					2-May-05	68
14-Dec-05	190					4-May-05	120
19-Dec-05	1770					9-May-05	550
27-Dec-05	440					16-May-05	128
3-Jan-06	20					23-May-05	60
10-Jan-06	80					1-Jun-05	148
17-Jan-06	40					6-Jun-05	64
23-Jan-06	20					13-Jun-05	128
						15-Jun-05	35
						23-Jun-05	60
						29-Jun-05	95
						5-Jul-05	36
						11-Jul-05	72

San Lorenzo River Mouth @ Trestle	Fecal Coliform (#/100 mL)	San Lorenzo River @ Broadway/ Laurel St Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Soquel Av Bridge	Fecal Coliform (#/100 mL)	San Lorenzo River @ Sycamore Grove	Fecal Coliform (#/100 mL)
						14-Jul-05	40
						18-Jul-05	156
						25-Jul-05	44
						1-Aug-05	44
						8-Aug-05	24
						15-Aug-05	32
						17-Aug-05	44
						22-Aug-05	48
						30-Aug-05	20
						6-Sep-05	48
						15-Sep-05	24
						19-Sep-05	8
						20-Sep-05	36
						27-Sep-05	40
						3-Oct-05	4
						11-Oct-05	48
						12-Oct-05	36
						18-Oct-05	15
						25-Oct-05	96
						1-Nov-05	16
						9-Nov-05	65
						15-Nov-05	50
						22-Nov-05	16
						30-Nov-05	315
						5-Dec-05	116
						9-Dec-05	40
						14-Dec-05	35
						19-Dec-05	1280
						27-Dec-05	220
						3-Jan-06	100
						10-Jan-06	76
						17-Jan-06	80
						23-Jan-06	28
						25-Jan-06	92

Branciforte Creek Water Quality Data

Branciforte Ck above SLR	Fecal Coliform (#/100 mL)	Branciforte Ck @ Carbonera Ck	Fecal Coliform (#/100 mL)	Branciforte Ck @ Isbel Dr	Fecal Coliform (#/100 mL)	Branciforte Ck @ Delaveaga	Fecal Coliform (#/100 mL)
11-Apr-95	216	20-Sep-95	88	09-Feb-00	230	30-Jun-03	268
23-Aug-95	528	19-Mar-96	190	23-Mar-00	250	09-Jul-03	120
05-Dec-95	1490	06-Feb-97	120	20-Apr-00	190	16-Jul-03	448
18-Dec-95	2140	20-Dec-00	90	25-May-00	340	22-Jul-03	88
03-Jan-96	1390	09-Jan-01	340	26-Jul-00	390	28-Jul-03	72
17-Jan-96	800	13-Aug-01	52	28-Aug-00		05-Aug-03	68
30-Jan-96	100	24-Jan-02	9	15-Nov-00	176	12-Aug-03	84
15-Feb-96	860			04-Dec-00	28	20-Aug-03	56
29-Feb-96	1400			09-Jan-01	540	25-Aug-03	172
29-May-96	680			07-Feb-01	112	04-Sep-03	168
11-Jun-96	620			28-Mar-01	230	15-Sep-03	170
26-Jun-96	890			23-Apr-01	4275	26-May-04	410
09-Jul-96	288			23-May-01	650	02-Jun-04	104
21-Aug-96	7170			20-Jun-01	96	09-Jun-04	90
23-Sep-96	870			30-Jul-01	170	15-Jun-04	120
07-Oct-96	280			13-Aug-01	92	21-Jun-04	188
23-Oct-96	720			28-Nov-01	90	29-Jun-04	100
29-Oct-96	11520			19-Dec-01	90	08-Jul-04	110
07-Nov-96	270			13-Jan-02	60	12-Jul-04	108
26-Nov-96	580			13-Feb-02	44	19-Jul-04	60
18-Dec-96	420			19-Mar-02	20	28-Jul-04	92
06-Jan-97	220			04-Jun-02	100	04-Aug-04	150
03-Feb-97	180			30-Jul-02	188	16-Aug-04	252
06-Feb-97	130			22-Aug-02	96	23-Aug-04	76
19-Feb-97	120			14-Nov-02	80	30-Aug-04	122
20-Dec-00	50			18-Dec-02	210	08-Sep-04	136
09-Jan-01	490			16-Jan-03	90	13-Sep-04	16
11-Dec-01				11-Feb-03	220	20-Sep-04	128
24-Jan-02	9			19-Mar-03	390	27-Sep-04	80
26-Feb-02	9			03-Jun-03	172	01-Jun-05	150
26-Sep-05	190			16-Jul-03	140	06-Jun-05	188
				28-Aug-03	232	13-Jun-05	84
				23-Sep-03	440	23-Jun-05	80
				13-Nov-03	190	29-Jun-05	150
				17-Dec-03	230	05-Jul-05	96
				06-Jan-04	80	11-Jul-05	40
				05-Feb-04	130		
				02-Mar-04	230		
				11-May-04	370		
				14-Jul-04	170		

Branciforte Ck above SLR	Fecal Coliform (#/100 mL)	Branciforte Ck @ Carbonera Ck	Fecal Coliform (#/100 mL)	Branciforte Ck @ Isbel Dr	Fecal Coliform (#/100 mL)	Branciforte Ck @ Delaveaga	Fecal Coliform (#/100 mL)
				02-Sep-04	125		
				07-Oct-04	805		
				03-Nov-04	120		
				25-Jan-05	335		
				09-Feb-05	68		
				10-Mar-05	80		
				13-Apr-05	140		
				04-May-05	220		
				15-Jun-05	380		

Carbonera Creek Data (Santa Cruz County Environmental Health Services Data)

Carbonera Creek @ Branciforte Creek	Fecal Coliform (#/100 mL)
19-Oct-00	44
20-Dec-00	40
09-Jan-01	360
13-Aug-01	1900
24-Jan-02	30
26-Feb-02	9
26-Sep-05	90
6-Oct-05	90

Carbonera Creek Data (City of Scotts Valley Data)

Stn #	Sampling Location	Sampling Date	*E. coli*
1	Camp Evers Cr. @ Cold Stream Way	16-Jan-05	36
1	Camp Evers Cr. @ Cold Stream Way	13-Jan-05	9
1	Camp Evers Cr. @ Cold Stream Way	20-Jan-05	610
1	Camp Evers Cr. @ Cold Stream Way	27-Jan-05	75
1	Camp Evers Cr. @ Cold Stream Way	10-Feb-05	4500
1	Camp Evers Cr. @ Cold Stream Way	17-Feb-05	160
2	Camp Evers Cr. @ Whispering Pines	16-Jan-05	2400
2	Camp Evers Cr. @ Whispering Pines	13-Jan-05	820
2	Camp Evers Cr. @ Whispering Pines	20-Jan-05	330
2	Camp Evers Cr. @ Whispering Pines	27-Jan-05	250
2	Camp Evers Cr. @ Whispering Pines	10-Feb-05	2000
2	Camp Evers Cr. @ Whispering Pines	17-Feb-05	290
3	Camp Evers Cr. @ Carbonera Cr.	16-Jan-05	66
3	Camp Evers Cr. @ Carbonera Cr.	13-Jan-05	770
3	Camp Evers Cr. @ Carbonera Cr.	20-Jan-05	120
3	Camp Evers Cr. @ Carbonera Cr.	27-Jan-05	520
3	Camp Evers Cr. @ Carbonera Cr.	10-Feb-05	104
3	Camp Evers Cr. @ Carbonera Cr.	17-Feb-05	140
4	Carbonera Cr. @ Disc Dr.	16-Jan-05	75
4	Carbonera Cr. @ Disc Dr.	13-Jan-05	57
4	Carbonera Cr. @ Disc Dr.	20-Jan-05	370
4	Carbonera Cr. @ Disc Dr.	27-Jan-05	390
4	Carbonera Cr. @ Disc Dr.	10-Feb-05	82
4	Carbonera Cr. @ Disc Dr.	17-Feb-05	370
5	Carbonera Cr. AB Camp Evers Cr.	16-Jan-05	59
5	Carbonera Cr. AB Camp Evers Cr.	13-Jan-05	33
5	Carbonera Cr. AB Camp Evers Cr.	20-Jan-05	200

5	Carbonera Cr. AB Camp Evers Cr.	27-Jan-05	870
5	Carbonera Cr. AB Camp Evers Cr.	10-Feb-05	150
5	Carbonera Cr. AB Camp Evers Cr.	17-Feb-05	180
6	Carbonera Cr. @ Hwy. 17	16-Jan-05	91
6	Carbonera Cr. @ Hwy. 17	13-Jan-05	120
6	Carbonera Cr. @ Hwy. 17	20-Jan-05	190
6	Carbonera Cr. @ Hwy. 17	27-Jan-05	460
6	Carbonera Cr. @ Hwy. 17	10-Feb-05	93
6	Carbonera Cr. @ Hwy. 17	17-Feb-05	270

APPENDIX TWO. DATA ANALYSIS

Staff analyzed water quality data using a program developed by Tetra Tech, the United States Environmental Protection Agencies' contractor. The program is titled "Fecal Coliform Investigation and Analysis Spreadsheet (FECIA)." FECIA is a fully automated spreadsheet designed to assist in characterization and quantification of fecal coliform instream water quality objective exceedances. Data are compared against water quality objectives to determine magnitude and frequency of exceedances. The FECIA program generated the data analysis figures and tables within this chapter.

All figures in Appendix Two show the REC-1 geometric mean water quality objective, concentration ranges, range of concentrations within the 25^{th} -75^{th} percentile range, mean concentration, and median concentration.

All tables in Appendix Two provide summary statistics of the figures. The table displays statistical data on a monthly basis. The table shows the mean, the median, the minimum, the maximum, the 25^{th} percent deviation, the 75^{th} percent deviation, the number of exceedances of the water contact recreation water quality objective versus the sample count (XS:Count), and the percent sample exceedance (XS%) of the water quality objective. Note that when the table analyzed geometric means, the column entitled "mean" is actually the "mean of the geometric mean." The mean value for maximum water quality objectives is the actual mean value of the samples collected.

San Lorenzo River Estuary at Trestle

Geometric Mean Water Quality Objective (200 MPN/100 mL)

Figure 1 shows monthly fecal coliform concentrations for the San Lorenzo River Estuary at the Trestle from 1/4/2000 to 2/28/2005. Fecal coliform mean values are below the water quality objective from January through May (February average equals 200 MPN). From June through December, the mean concentrations exceed the water quality objective.

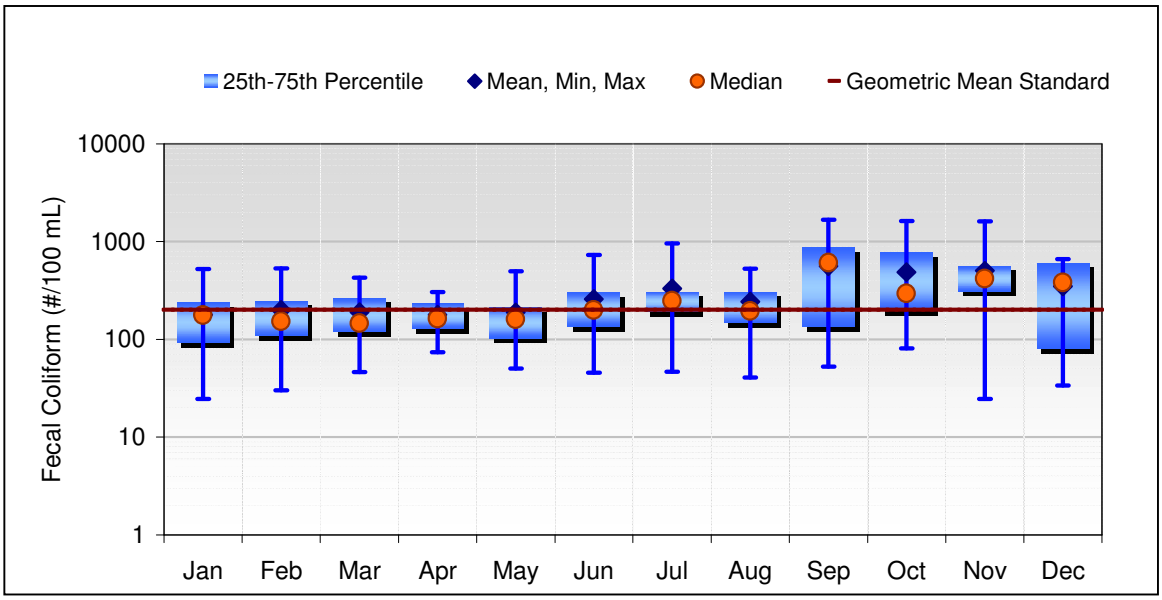

Figure 1. San Lorenzo River Estuary Fecal Coliform at Trestle (#/100 mL) and Water Contact Recreation Geometric Mean Water Quality Objective (January 4, 2000 – February 28, 2005)

Table 1below provides summary statistics of the above figure. Overall, the water quality objective was exceeded 52% of the time. The least violations occur in April and the greatest numbers of violations occur in November. The number of exceedances is slightly less from February though May. There is no seasonal water quality trend.

Table 1. San Lorenzo River Estuary Fecal Coliform at Trestle Data Summary (#/100 mL) and Exceedance of Water Contract Recreation Geometric Mean Water Quality Objective

Summary Statistics (Data: 1/4/2000 to 2/28/2005)								
Month	Mean	Median	Min	Max	25th	75th	XS:Count	XS%
Jan	179	178	25	522	92	239	9:21	43%
Feb	200	154	30	532	109	249	9:22	41%
Mar	190	147	46	430	119	264	8:23	35%
Apr	178	164	74	304	128	233	7:24	29%
May	189	162	50	498	103	212	7:21	33%
Jun	259	200	46	728	136	304	11:23	48%
Jul	330	248	47	955	192	307	16:22	73%
Aug	243	195	41	529	147	307	10:22	45%
Sep	562	608	52	1669	134	870	13:22	59%
Oct	489	295	81	1620	196	775	18:24	75%
Nov	503	417	25	1609	310	562	17:22	77%
Dec	348	383	34	662	80	606	15:24	63%
All Data	**307**	**212**	**25**	**1669**	**132**	**376**	**140:270**	**52%**

Maximum Water Quality Objective (400 MPN/100 mL)

Figure 2 below shows monthly fecal coliform concentrations for San Lorenzo River Estuary at the Trestle from 1/4/2000 to 2/28/2005. Mean concentrations exceed the water quality objective in February and May through December.

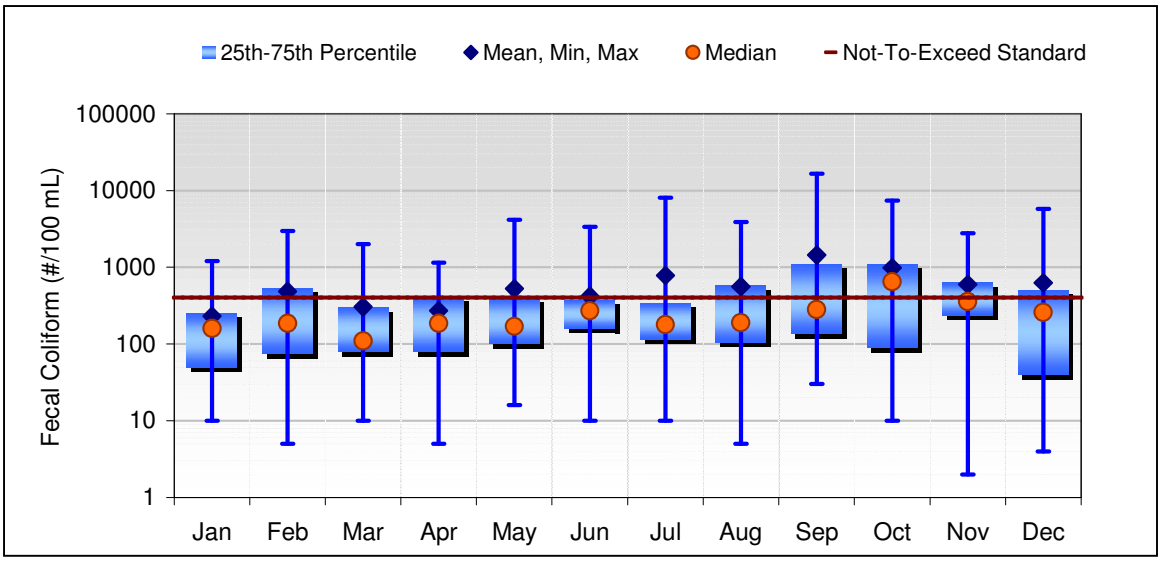

Figure 2. San Lorenzo River Estuary Fecal Coliform at Trestle (#/100 mL) and Water Contact Maximum Water Quality Objective (January 4, 2000 through February 28, 2005)

Table 2 below provides summary statistics of the above figure. Overall, the quality objective was exceeded 30% of the time with no seasonal trend.

Table 2. San Lorenzo River Estuary Fecal Coliform at Trestle Data Summary (#/100 mL) and Exceedance of Water Contract Recreation Maximum Water Quality Objective

Summary Statistics (Data: 1/4/2000 to 2/28/2005)								
Month	**Mean**	**Median**	**Min**	**Max**	**25th**	**75th**	**XS:Count**	**XS%**
Jan	229	160	10	1200	50	255	3:27	11%
Feb	485	185	5	2976	75	540	8:26	31%
Mar	304	110	10	2000	80	305	5:23	22%
Apr	272	185	5	1150	80	420	6:24	25%
May	528	170	16	4170	100	400	5:21	24%
Jun	422	271	10	3350	160	378	6:24	25%
Jul	784	180	10	8040	115	345	4:23	17%
Aug	559	190	5	3910	105	577	7:24	29%
Sep	1445	280	30	16632	135	1110	10:23	43%
Oct	989	645	10	7420	89	1097	14:24	58%
Nov	598	360	2	2780	238	633	8:22	36%
Dec	627	260	4	5760	40	510	10:25	40%
All Data	**597**	**210**	**2**	**16632**	**90**	**550**	**86:286**	**30%**

San Lorenzo River Estuary at Broadway/Laurel Street Bridge

Geometric Mean Water Quality Objective (200 MPN/100 mL)

Figure 3 below shows monthly fecal coliform concentrations for San Lorenzo River Estuary at the Broadway/Laurel Street from 1/4/2000 to 2/28/2005. Mean concentrations exceed the water quality objective in February and June through December.

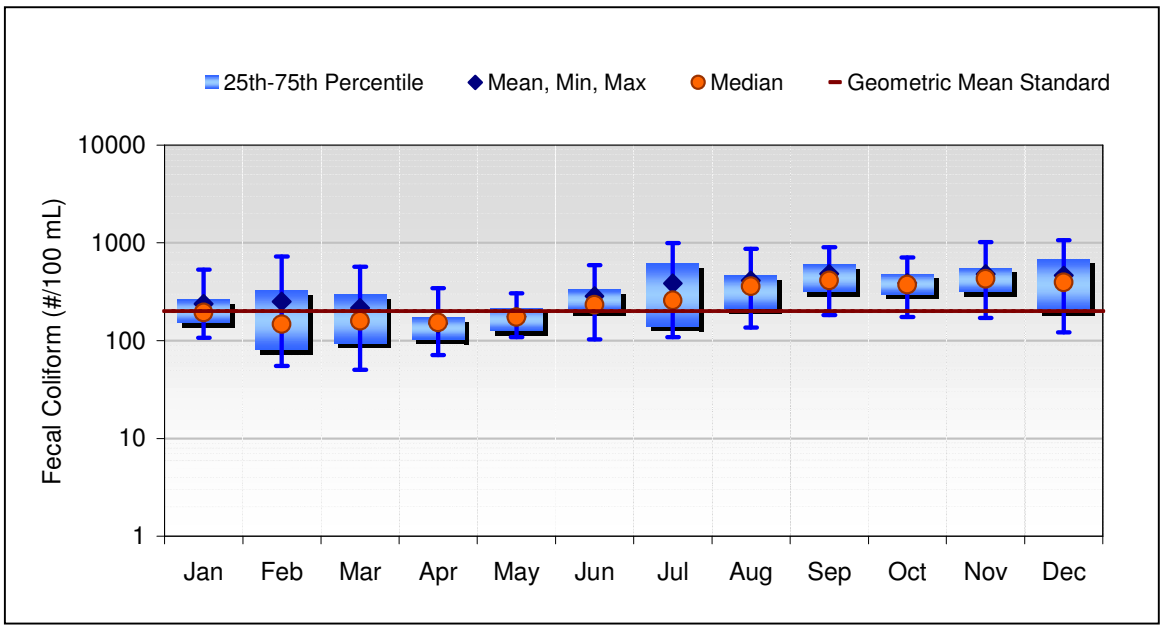

Figure 3. San Lorenzo River Estuary Fecal Coliform at Broadway/Laurel Bridge (#/100 mL) and Water Contact Recreation Geometric Mean Water Quality Objective (January 4, 2000 through February 28, 2005)

Table 3 below provides summary statistics of the above figure. Overall, the water quality objective was exceeded 61% of the time with no apparent seasonal trend.

Table 3. San Lorenzo River Estuary Fecal Coliform at Broadway/Laurel Street Bridge Data Summary (#/100 mL) and Exceedance of Water Contract Recreation Geometric Mean Water Quality Objective

Summary Statistics (Data: 1/4/2000 to 2/28/2005)								
Month	Mean	Median	Min	Max	25th	75th	XS:Count	XS%
Jan	238	194	106	534	152	262	8:17	47%
Feb	251	147	55	724	81	330	9:20	45%
Mar	216	159	50	570	94	296	8:19	42%
Apr	151	153	72	343	103	173	3:21	14%
May	176	174	108	305	126	214	6:17	35%
Jun	286	233	104	593	204	332	14:19	74%
Jul	385	258	109	994	140	616	11:19	58%
Aug	414	358	136	870	210	465	13:17	76%
Sep	480	413	183	903	316	607	16:17	94%
Oct	388	373	174	711	299	482	16:18	89%
Nov	478	428	171	1016	315	557	16:19	84%
Dec	463	395	121	1068	200	688	17:23	74%
All Data	**327**	**254**	**50**	**1068**	**154**	**439**	**137:226**	**61%**

Maximum Water Quality Objective (400 MPN/100 mL)

Figure 4 below shows monthly fecal coliform concentrations for San Lorenzo River Estuary at the Broadway/Laurel Street Bridge from 1/4/2000 to 2/28/2005. Mean concentrations exceed the water quality objective in February and July through December.

Figure 4. San Lorenzo River Estuary Fecal Coliform at Broadway/Laurel Street Bridge (#/100 mL) and Water Contact Maximum Water quality Objective (January 4, 2000 through February 29, 2005)

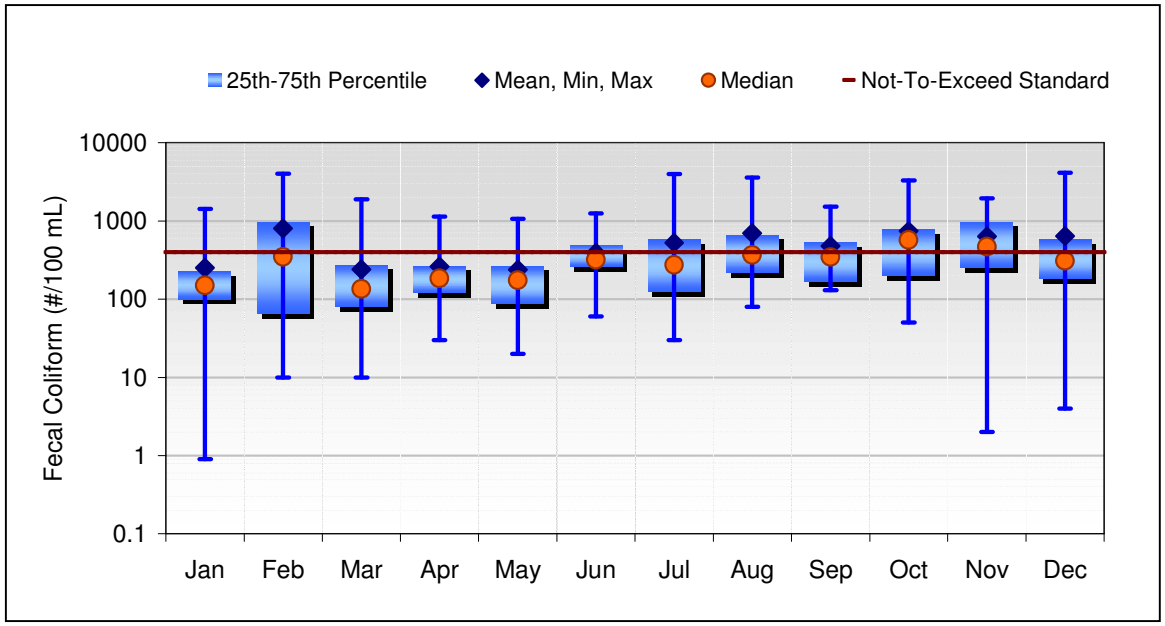

Table 4 below provides summary statistics of the above figure. Overall, the water quality objective was exceeded 35% of the time. The number of exceedances is lower in March through May. There is no seasonal trend.

Table 4. San Lorenzo River Estuary Fecal Coliform at Broadway/Laurel Street Bridge Data Summary (#/100 mL) and Exceedance of Water Contract Recreation Maximum Water Quality Objective

Summary Statistics (Data: 1/4/2000 to 2/28/2005)								
Month	Mean	Median	Min	Max	25th	75th	XS:Count	XS%
Jan	252	150	1	1430	100	228	6:26	23%
Feb	804	350	10	4000	65	983	9:23	39%
Mar	240	135	10	1900	80	275	2:22	9%
Apr	262	185	30	1140	120	265	3:22	14%
May	239	175	20	1060	88	265	3:20	15%
Jun	393	320	60	1250	260	490	7:21	33%
Jul	529	274	30	3970	125	578	8:22	36%
Aug	698	370	80	3580	216	660	10:21	48%
Sep	479	346	130	1530	167	542	9:20	45%
Oct	745	570	50	3300	200	780	14:21	67%
Nov	635	470	2	1940	250	970	13:21	62%
Dec	645	310	4	4150	180	575	9:23	39%
All Data	**492**	**267**	**1**	**4150**	**130**	**538**	**93:262**	**35%**

San Lorenzo River Fecal Coliform at Soquel Avenue Bridge

Geometric Mean Objective (200 MPN/100 mL)

There are insufficient water quality data at the Soquel Avenue Bridge station to calculate the geometric mean (No months have the minimum of five samples needed to calculate the geometric mean). The most recent data available is from 11/24/86 to 02/19/97.

Maximum Objective (400 MPN/100 mL)

Figure 5 shows monthly fecal coliform concentrations for San Lorenzo River Estuary at the Soquel Avenue Bridge from 11/24/1986 to 02/19/1997. The mean concentrations exceed the water quality objective in January, April-May, August, and October through December.

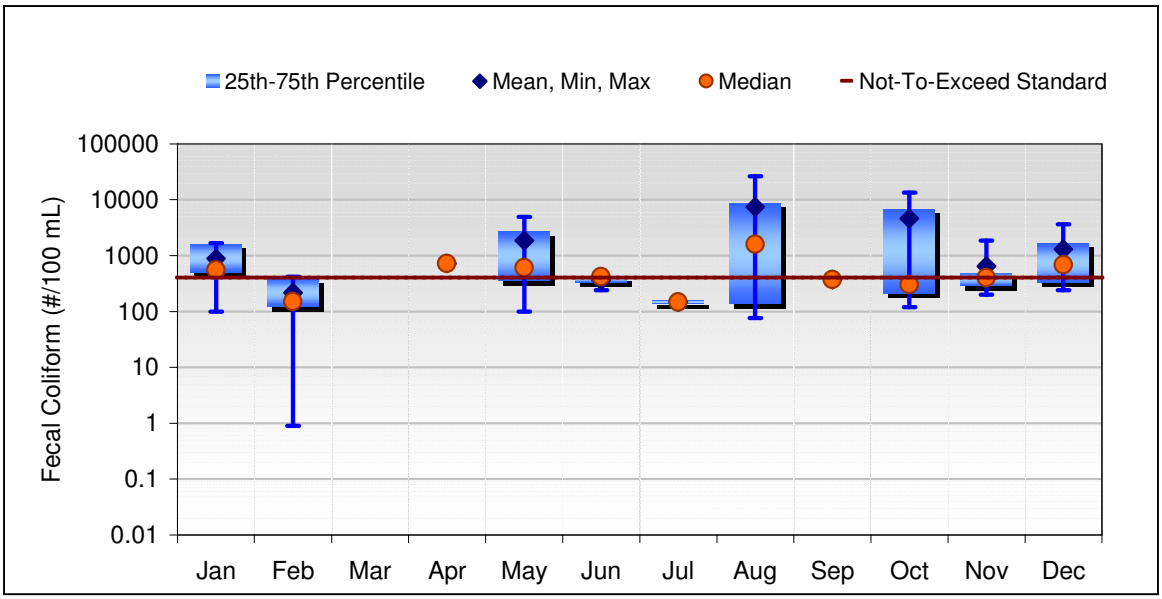

Figure 5. San Lorenzo River Estuary Fecal Coliform at Soquel Avenue Bridge Data Summary (#/100 mL) and Exceedance of Water Contract Recreation Maximum Water Quality Objective (11/24/1986 to 2/19/1997)

Table 5 below provides summary statistics of the above figure. Overall, the water quality objective was exceeded 47% of the time. There is no seasonal trend.

Table 5. San Lorenzo River Estuary Fecal Coliform at Soquel Avenue Bridge Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Objective

Summary Statistics (Data: 11/24/1986 to 2/19/1997)								
Month	**Mean**	**Median**	**Min**	**Max**	**25th**	**75th**	**XS:Count**	**XS%**
Jan	882	550	100	1660	500	1600	4:5	80%
Feb	217	150	1	420	120	392	1:5	20%
Mar	0	0	0	0	0	0	0:0	n/a
Apr	720	720	720	720	720	720	1:1	100%
May	1868	604	100	4900	352	2752	2:3	67%
Jun	360	420	240	420	330	420	2:3	67%
Jul	147	147	125	168	136	157	0:2	0%
Aug	7416	1593	76	26400	136	8873	2:4	50%
Sep	370	370	370	370	370	370	0:1	0%
Oct	4573	300	120	13300	210	6800	1:3	33%
Nov	646	400	200	1850	290	490	2:5	40%
Dec	1308	685	240	3620	330	1663	2:4	50%
All Data	**1817**	**396**	**1**	**26400**	**165**	**793**	**17:36**	**47%**

San Lorenzo River at Sycamore Grove

Geometric Mean Objective (200 MPN/100 mL)

Figure 6 below shows monthly fecal coliform concentrations for San Lorenzo River Estuary at the Sycamore Grove station from 1/4/2000 to 2/22/2005. The mean concentrations do not exceed the water quality objective.

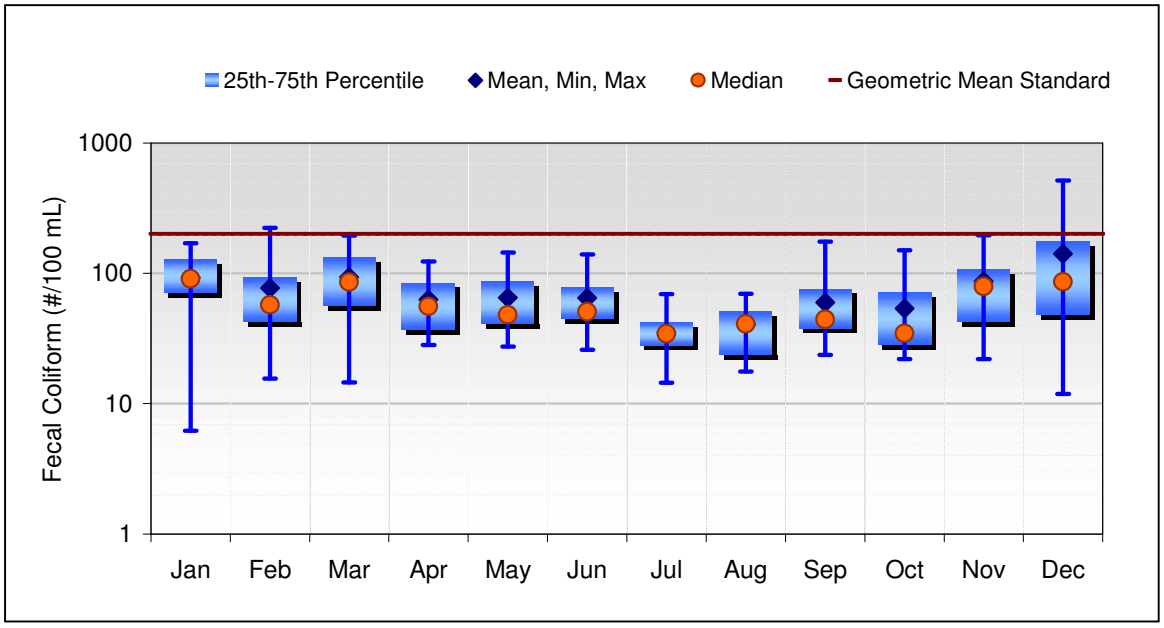

Figure 6. San Lorenzo River Fecal Coliform at Sycamore Grove (#/100 mL) and Water Contact Recreation Geometric Mean Water Quality Objective (January 4, 2000 – February 21, 2005)

Table 6 below provides summary statistics of the above figure. Overall, the water quality objective was exceeded only 2% of the time.

Table 6. San Lorenzo River Estuary Fecal Coliform at Sycamore Grove Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Geometric Mean Objective

Summary Statistics (Data: 1/4/2000 to 2/21/2005)								
Month	Mean	Median	Min	Max	25th	75th	XS:Count	XS%
Jan	93	91	6	170	71	128	0:24	0%
Feb	77	58	16	224	43	93	1:29	3%
Mar	94	86	15	195	57	132	0:27	0%
Apr	63	56	28	123	37	84	0:26	0%
May	65	48	27	145	41	87	0:23	0%
Jun	65	51	26	139	45	78	0:26	0%
Jul	35	35	15	69	28	42	0:27	0%
Aug	40	41	18	70	24	51	0:26	0%
Sep	60	44	24	175	38	76	0:26	0%
Oct	54	35	22	150	28	71	0:25	0%
Nov	87	79	22	197	42	107	0:24	0%
Dec	142	86	12	516	48	176	6:27	22%
All Data	**73**	**51**	**6**	**516**	**35**	**92**	**7:310**	**2%**

Maximum Water Quality Objective (400 MPN/100 mL)

Figure 7 shows monthly fecal coliform concentrations for San Lorenzo River at Sycamore Grove station from 1/4/2000 to 2/21/2005. Mean concentrations do not exceed the water quality objective.

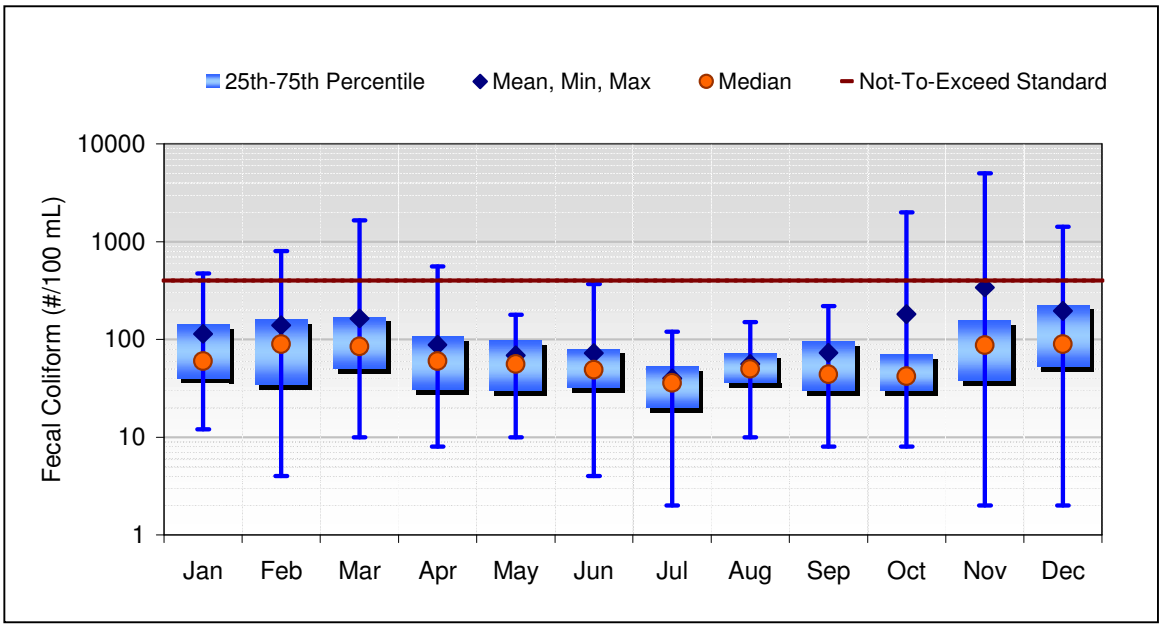

Figure 7. San Lorenzo River Fecal Coliform at Sycamore Grove (#/100 mL) and Water Contact Maximum Water Quality Objective (January 4, 2000 – February 21, 2005)

Table 7 below provides summary statistics of the above figure. Overall, the water quality objective was exceeded only 4% of the time.

Table 7. San Lorenzo River Fecal Coliform at Sycamore Grove Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Standard

Summary Statistics (Data: 1/4/2000 to 2/21/2005)								
Month	**Mean**	**Median**	**Min**	**Max**	**25th**	**75th**	**XS:Count**	**XS%**
Jan	115	60	12	472	40	143	2:31	6%
Feb	140	90	4	800	35	160	2:28	7%
Mar	165	85	10	1650	50	170	1:26	4%
Apr	88	60	8	560	31	108	1:26	4%
May	69	56	10	180	30	99	0:24	0%
Jun	73	49	4	370	32	80	0:26	0%
Jul	40	36	2	120	20	53	0:28	0%
Aug	56	50	10	150	36	72	0:25	0%
Sep	73	44	8	220	30	96	0:25	0%
Oct	182	42	8	2000	30	70	2:26	8%
Nov	341	88	2	5000	38	158	3:24	13%
Dec	196	90	2	1430	53	228	3:26	12%
All Data	**127**	**60**	**2**	**5000**	**31**	**110**	**14:315**	**4%**

Branciforte Creek at San Lorenzo River

Geometric Mean Water Quality Objective (200 MPN/100 mL)

There are insufficient water quality data at the Branciforte Creek station upstream of the San Lorenzo River to calculate geometric means. The most recent data available is from 04/11/95 to 2/26/2002. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water Quality Objective (400 MPN/100 mL)

Figure 8 below shows monthly fecal coliform concentrations for Branciforte Creek at the San Lorenzo River confluence from 04/11/1995 to 2/26/2002. (This is the most recent data available.) Mean concentrations exceed the water quality objective almost every month. There was no data available for March. April, May, July, and September only had one sample.

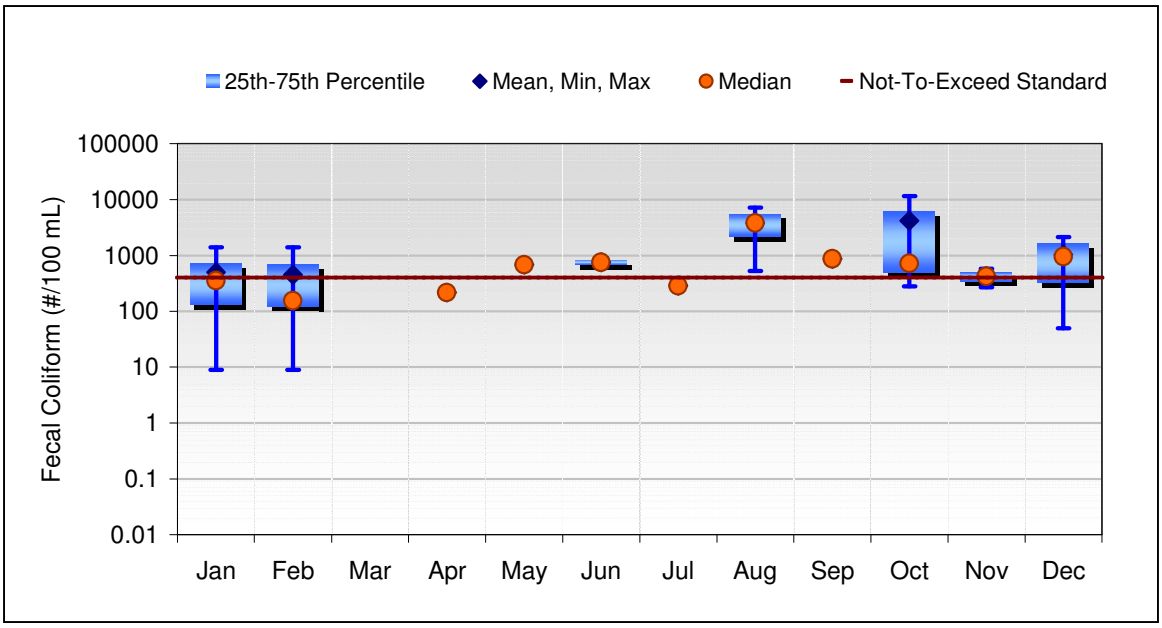

Figure 8. Branciforte Creek at San Lorenzo River Fecal Coliform (#/100 mL) and Water Contact Recreation Maximum Water Quality Objective (April 11, 1995 – February 26, 2002)

Table 8 below provides summary statistics of the above figure. Overall, the water quality objective was exceeded 59% of the time. There is no seasonal trend.

Table 8. Branciforte Creek Fecal Coliform at San Lorenzo River Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Objective

Summary Statistics (Data: 4/11/1995 to 2/26/2002)								
Month	Mean	Median	Min	Max	25th	75th	XS:Count	XS%
Jan	502	355	9	1390	130	723	3:6	50%
Feb	450	155	9	1400	123	690	2:6	33%
Mar	0	0	0	0	0	0	0:0	n/a
Apr	216	216	216	216	216	216	0:1	0%
May	680	680	680	680	680	680	1:1	100%
Jun	755	755	620	890	688	823	2:2	100%
Jul	288	288	288	288	288	288	0:1	0%
Aug	3849	3849	528	7170	2189	5510	2:2	100%
Sep	870	870	870	870	870	870	1:1	100%
Oct	4173	720	280	11520	500	6120	2:3	67%
Nov	425	425	270	580	348	503	1:2	50%
Dec	1025	955	50	2140	328	1653	3:4	75%
All Data	**1188**	**528**	**9**	**11520**	**216**	**870**	**17:29**	**59%**

Branciforte Creek at Carbonera

Geometric Mean Water Quality Objective (200 MPN/100 mL)

There are insufficient water quality data at the Branciforte Creek station upstream of the confluence with Carbonera Creek. The most recent data available is from 9/20/1995 to 1/24/2002. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water Quality Objective (400 MPN/100 mL)

Figure 9 below shows monthly fecal coliform concentrations for Branciforte Creek at the Carbonera Creek confluence from 9/20/1995 to 1/24/2002. (This is the most recent data available.) The means did not exceed the water quality objective. However, as show in the figure below, there are insufficient data to determine impairment conditions, because there are only seven samples for this timeframe.

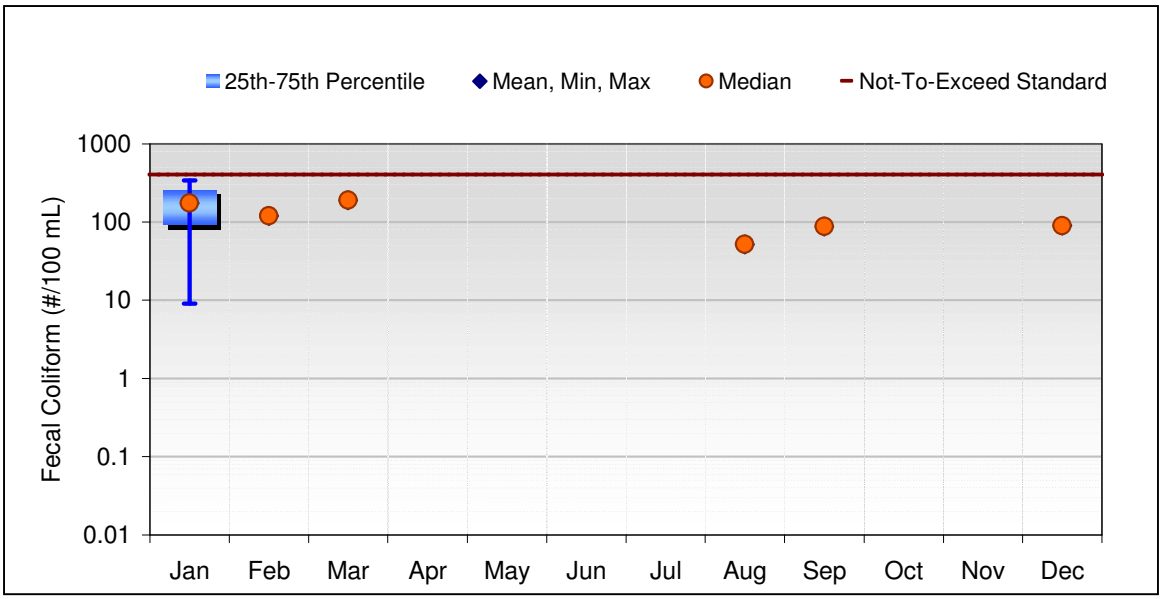

Figure 9. Branciforte Creek Fecal Coliform at San Lorenzo River Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Objective (September 20, 1995 – January 24, 2002)

Table 9. Branciforte Creek Fecal Coliform at Carbonera Creek Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Objective

Summary Statistics (Data: 9/20/1995 to 1/24/2002)								
Month	Mean	Median	Min	Max	25th	75th	XS:Count	XS%
Jan	175	175	9	340	92	257	0:2	0%
Feb	120	120	120	120	120	120	0:1	0%
Mar	190	190	190	190	190	190	0:1	0%
Apr	0	0	0	0	0	0	0:0	n/a
May	0	0	0	0	0	0	0:0	n/a
Jun	0	0	0	0	0	0	0:0	n/a
Jul	0	0	0	0	0	0	0:0	n/a
Aug	52	52	52	52	52	52	0:1	0%
Sep	88	88	88	88	88	88	0:1	0%
Oct	0	0	0	0	0	0	0:0	n/a
Nov	0	0	0	0	0	0	0:0	n/a
Dec	90	90	90	90	90	90	0:1	0%
All Data	**127**	**90**	**9**	**340**	**70**	**155**	**0:7**	**0%**

Branciforte Creek at Isbel Drive

Geometric Mean Water Quality Objective (200 MPN/100 mL)

There are insufficient water quality data at the Isbel Drive station. The most recent data available is from 2/9/2000 to 6/15/2005. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water Quality Objective (400 MPN/100 mL)

Figure 10 below shows monthly fecal coliform concentrations for Branciforte Creek at Isbel Drive from 2/9/2000 to 6/15/2005. The mean concentration exceeded the objective only in April.

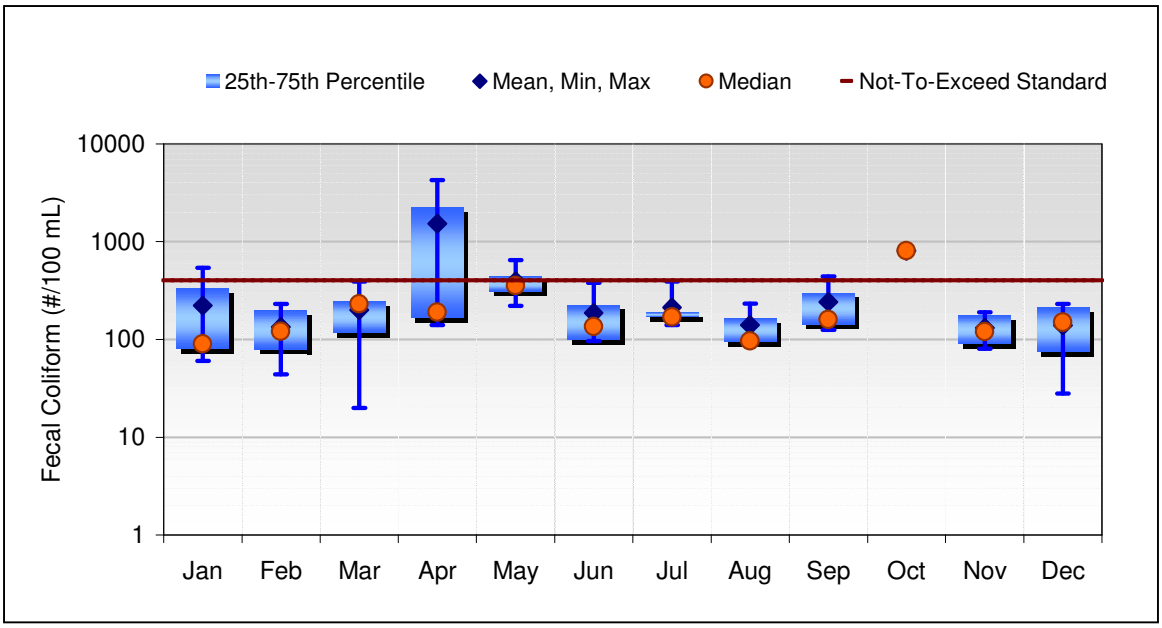

Figure 10. Branciforte Creek at Isbel Drive Fecal Coliform (#/100 mL) and Water Contact Recreation Maximum Water Quality Objective (February 9, 2000 – June 15, 2005)

Table 10 below provides summary statistics of the above figure. Overall, the water quality objective was exceeded 10% of the time. There is no seasonal trend.

Table 10. Branciforte Creek Fecal Coliform at Isbel Drive Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Objective

Summary Statistics (Data: 2/9/2000 to 6/15/2005)								
Month	**Mean**	**Median**	**Min**	**Max**	**25th**	**75th**	**XS:Count**	**XS%**
Jan	221	90	60	540	80	335	1:5	20%
Feb	134	121	44	230	79	198	0:6	0%
Mar	200	230	20	390	118	245	0:6	0%
Apr	1535	190	140	4275	165	2233	1:3	33%
May	395	355	220	650	310	440	1:4	25%
Jun	187	136	96	380	99	224	0:4	0%
Jul	212	170	140	390	170	188	0:5	0%
Aug	140	96	92	232	94	164	0:3	0%
Sep	242	160	125	440	143	300	1:3	33%
Oct	805	805	805	805	805	805	1:1	100%
Nov	131	120	80	190	90	176	0:5	0%
Dec	140	150	28	230	75	215	0:4	0%
All Data	**291**	**172**	**20**	**4275**	**96**	**232**	**5:49**	**10%**

Carbonera Creek at Branciforte Creek

Geometric Mean Water Quality Objective (200 MPN/100 mL)

There are insufficient water quality data at the Carbonera Creek station from 10/19/2000 to 02/26/2002. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water Quality Objective (400 MPN/100 mL)

Figure 11 below shows monthly fecal coliform concentrations for Carbonera Creek at the Branciforte Creek confluence from 10/19/2000 to 02/26/2002. The means do not exceed the water quality objective. However, as show in the figure below, there are insufficient data to determine impairment conditions, because many months either had no sample or only one sample taken.

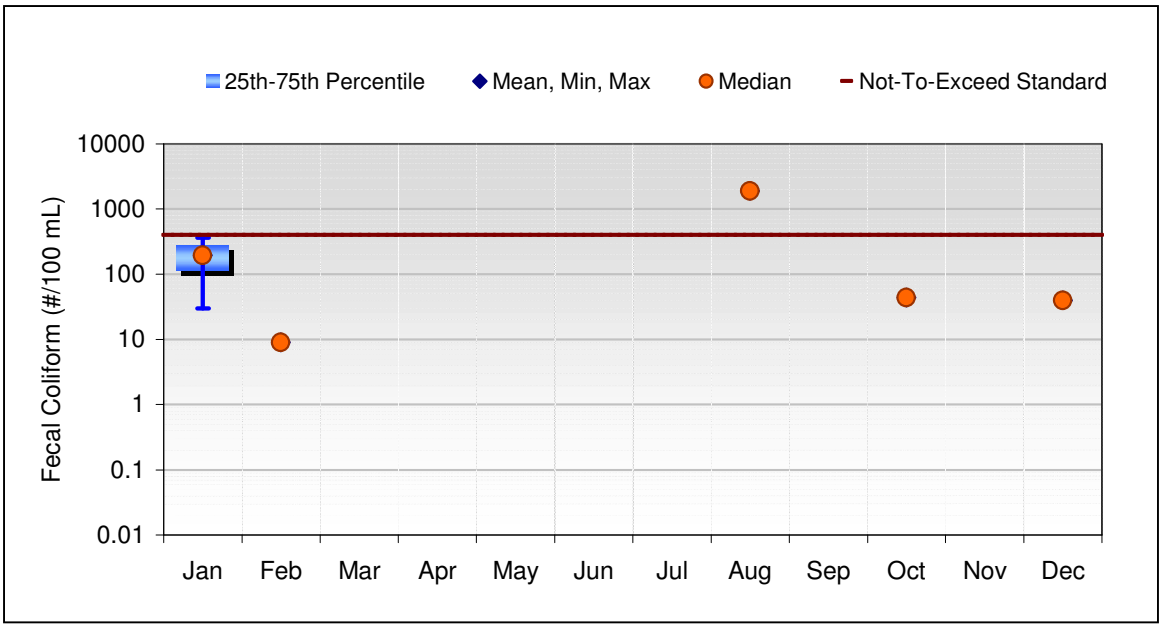

Figure 11. Carbonera Creek at Branciforte Creek Fecal Coliform (#/100 mL) and Water Contact Recreation Maximum Water Quality Objective (October 19, 2000 – February 26, 2002)

Table 11 below provides summary statistics of the above figure. Overall, the water quality objective was exceeded 17% of the time. There are insufficient data to determine impairment conditions, because many months had either no sample or only one sample taken.

Table 11. Carbonera Creek Fecal Coliform at Branciforte Creek Data Summary (#/100 mL) and

Exceedance of Water Contact Recreation Maximum Objective

Summary Statistics (Data: 10/19/2000 to 2/26/2002)								
Month	**Mean**	**Median**	**Min**	**Max**	**25th**	**75th**	**XS:Count**	**XS%**
Jan	195	195	30	360	113	278	0:2	0%
Feb	9	9	9	9	9	9	0:1	0%
Mar	0	0	0	0	0	0	0:0	n/a
Apr	0	0	0	0	0	0	0:0	n/a
May	0	0	0	0	0	0	0:0	n/a
Jun	0	0	0	0	0	0	0:0	n/a
Jul	0	0	0	0	0	0	0:0	n/a
Aug	1900	1900	1900	1900	1900	1900	1:1	100%
Sep	0	0	0	0	0	0	0:0	n/a
Oct	44	44	44	44	44	44	0:1	0%
Nov	0	0	0	0	0	0	0:0	n/a
Dec	40	40	40	40	40	40	0:1	0%
All Data	**397**	**42**	**9**	**1900**	**33**	**281**	**1:6**	**17%**

Carbonera Creek at Highway 17

Geometric Mean *E. coli* Water Quality Criteria (126 MPN/100 mL)

There are insufficient water quality data at the Carbonera Creek station from 1/6/2005 to 2/17/2005. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water *E. coli* Quality Criteria (235 MPN/100 mL)

Figure 11 below shows monthly *E.coli* concentrations for Carbonera Creek at Highway 17 from 1/6/2005 to 2/17/2005. The mean concentrations do not exceed the water quality objective. However, as shown in the figure below, there are insufficient data to fully determine impairment conditions because many months had no samples. The month of January in 2005 had four samples and the month of February in 2005 had two samples.

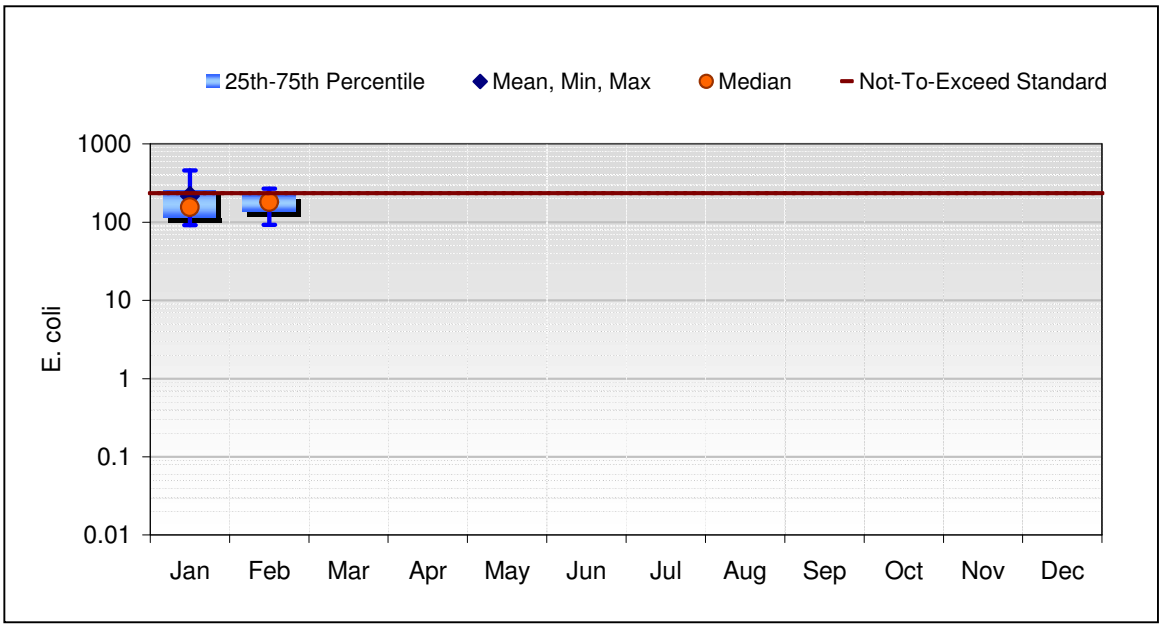

Figure 12. Carbonera Creek at Highway 17 (#/100 mL) and Water Contact Recreation Maximum Water Quality Criteria (January 06, 2005- February 17, 2005)

Table 11 below provides summary statistics of the above figure. Based on two months of sampling, the water quality criterion was exceeded 33% of the time. There are insufficient data to determine impairment conditions for all months, but the impairment occurred in January and February.

Table 16. Carbonera Creek *E.coli* at Highway 17 Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Objective

Summary Statistics (Data: 1/6/2005 to 2/17/2005)								
Month	**Mean**	**Median**	**Min**	**Max**	**25th**	**75th**	**XS:Count**	**XS%**
Jan	215	155	91	460	113	258	1:4	25%
Feb	182	182	93	270	137	226	1:2	50%
Mar	0	0	0	0	0	0	0:0	n/a
Apr	0	0	0	0	0	0	0:0	n/a
May	0	0	0	0	0	0	0:0	n/a
Jun	0	0	0	0	0	0	0:0	n/a
Jul	0	0	0	0	0	0	0:0	n/a
Aug	0	0	0	0	0	0	0:0	n/a
Sep	0	0	0	0	0	0	0:0	n/a
Oct	0	0	0	0	0	0	0:0	n/a
Nov	0	0	0	0	0	0	0:0	n/a
Dec	0	0	0	0	0	0	0:0	n/a
All Data	**204**	**155**	**91**	**460**	**100**	**250**	**2:6**	**33%**

Carbonera Creek above Camp Evers Creek

Geometric Mean *E. coli* Water Quality Criteria (126 MPN/100 mL)

There are insufficient water quality data at this station from 1/6/2005 to 2/17/2005. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water *E. coli* Quality Criteria (235 MPN/100 mL)

Figure 11 below shows monthly *E.coli* concentrations for Carbonera Creek above Camp Evers Creek from 1/6/2005 to 2/17/2005. The mean concentrations do not exceed the water quality objective. However, as shown in the figure below, there are insufficient data to determine impairment conditions, because many months had no samples. The month of January in 2005 had four samples and the month of February in 2005 had two samples.

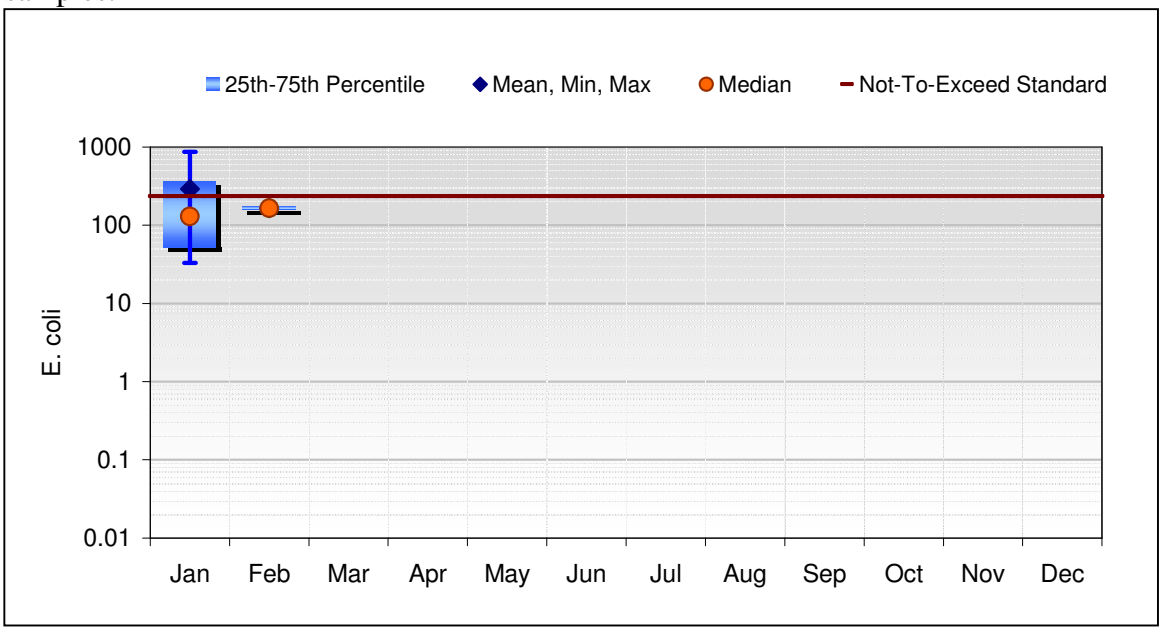

Figure 13. Carbonera Creek above Camp Evers Creek (#/100 mL) and Water Contact Recreation Maximum Water Quality Criteria (January 06, 2005- February 17, 2005)

Table 11 below provides summary statistics of the above figure. Based on two months of sampling, the water quality criterion was exceeded 17% of the time. There are insufficient data to determine impairment conditions for all months, but the impairment occurred in January.

Table 17. Carbonera Creek E.coli above Camp Evers Creek Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Objective

Summary Statistics (Data: 1/6/2005 to 2/17/2005)								
Month	Mean	Median	Min	Max	25th	75th	XS:Count	XS%
Jan	291	130	33	870	53	368	1:4	25%
Feb	165	165	150	180	158	173	0:2	0%

Mar	0	0	0	0	0	0	0:0	n/a
Apr	0	0	0	0	0	0	0:0	n/a
May	0	0	0	0	0	0	0:0	n/a
Jun	0	0	0	0	0	0	0:0	n/a
Jul	0	0	0	0	0	0	0:0	n/a
Aug	0	0	0	0	0	0	0:0	n/a
Sep	0	0	0	0	0	0	0:0	n/a
Oct	0	0	0	0	0	0	0:0	n/a
Nov	0	0	0	0	0	0	0:0	n/a
Dec	0	0	0	0	0	0	0:0	n/a
All Data	**249**	**165**	**33**	**870**	**82**	**195**	**1:6**	**17%**

Carbonera Creek at Disc Drive

Geometric Mean *E. coli* Water Quality Criteria (126 MPN/100 mL)

There are insufficient water quality data at this station from 1/6/2005 to 2/17/2005. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water *E. coli* Quality Criteria (235 MPN/100 mL)

Figure 11 below shows monthly *E.coli* concentrations for Carbonera Creek above Camp Evers Creek from 1/6/2005 to 2/17/2005. The mean concentrations do not exceed the water quality objective. However, as shown in the figure below, there are insufficient data to determine impairment conditions, because many months had no samples. The month of January in 2005 had four samples and the month of February in 2005 had two samples.

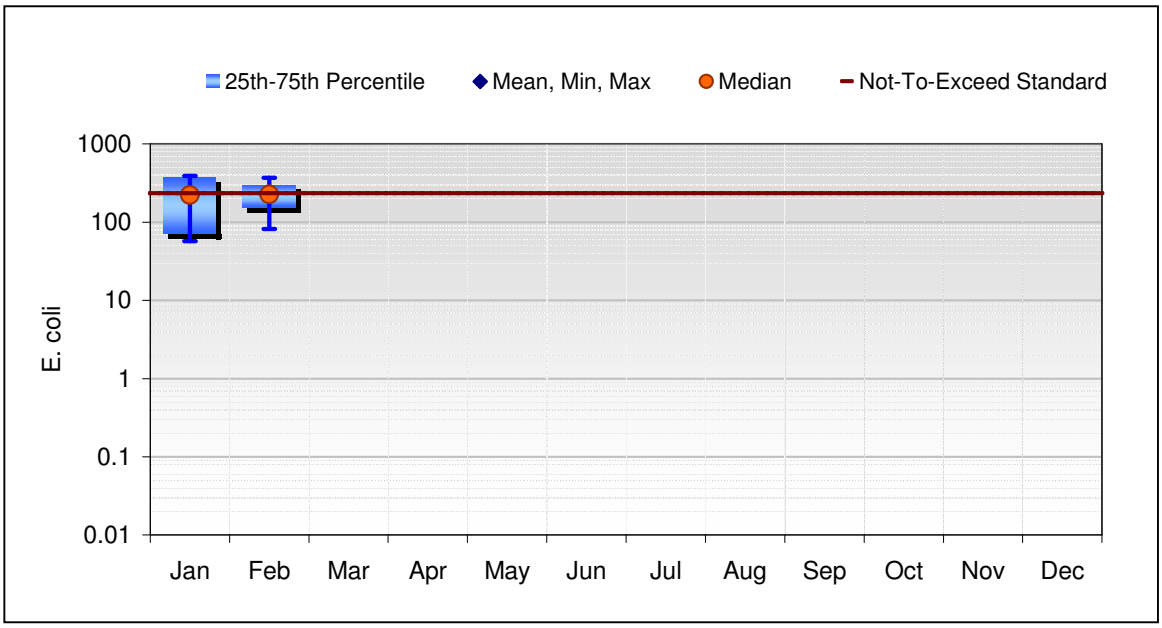

Figure 14. Carbonera Creek at Disc Drive (#/100 mL) and Water Contact Recreation Maximum Water Quality Criteria (January 06, 2005- February 17, 2005)

Table 11 below provides summary statistics of the above figure. Based on two months of sampling, the water quality criterion was exceeded 50% of the time. There are insufficient data to determine impairment conditions for all months, but the impairment occurred in January and February.

Table 18. Carbonera Creek E.coli at Disc Drive Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Objective

Summary Statistics (Data: 1/6/2005 to 2/17/2005)								
Month	**Mean**	**Median**	**Min**	**Max**	**25th**	**75th**	**XS:Count**	**XS%**
Jan	223	223	57	390	71	375	2:4	50%
Feb	226	226	82	370	154	298	1:2	50%
Mar	0	0	0	0	0	0	0:0	n/a
Apr	0	0	0	0	0	0	0:0	n/a
May	0	0	0	0	0	0	0:0	n/a
Jun	0	0	0	0	0	0	0:0	n/a
Jul	0	0	0	0	0	0	0:0	n/a
Aug	0	0	0	0	0	0	0:0	n/a
Sep	0	0	0	0	0	0	0:0	n/a
Oct	0	0	0	0	0	0	0:0	n/a
Nov	0	0	0	0	0	0	0:0	n/a
Dec	0	0	0	0	0	0	0:0	n/a
All Data	**224**	**226**	**57**	**390**	**77**	**370**	**3:6**	**50%**

Camp Evers Creek at Carbonera Creek

Geometric Mean *E. coli* Water Quality Criteria (126 MPN/100 mL)

There are insufficient water quality data at this station from 1/6/2005 to 2/17/2005. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water *E. coli* Quality Criteria (235 MPN/100 mL)

Figure 11 below shows monthly *E.coli* concentrations for Carbonera Creek above Camp Evers Creek from 1/6/2005 to 2/17/2005. The mean concentrations do not exceed the water quality objective. However, as shown in the figure below, there are insufficient data to determine impairment conditions, because many months had no samples. The month of January in 2005 had four samples and the month of February in 2005 had two samples.

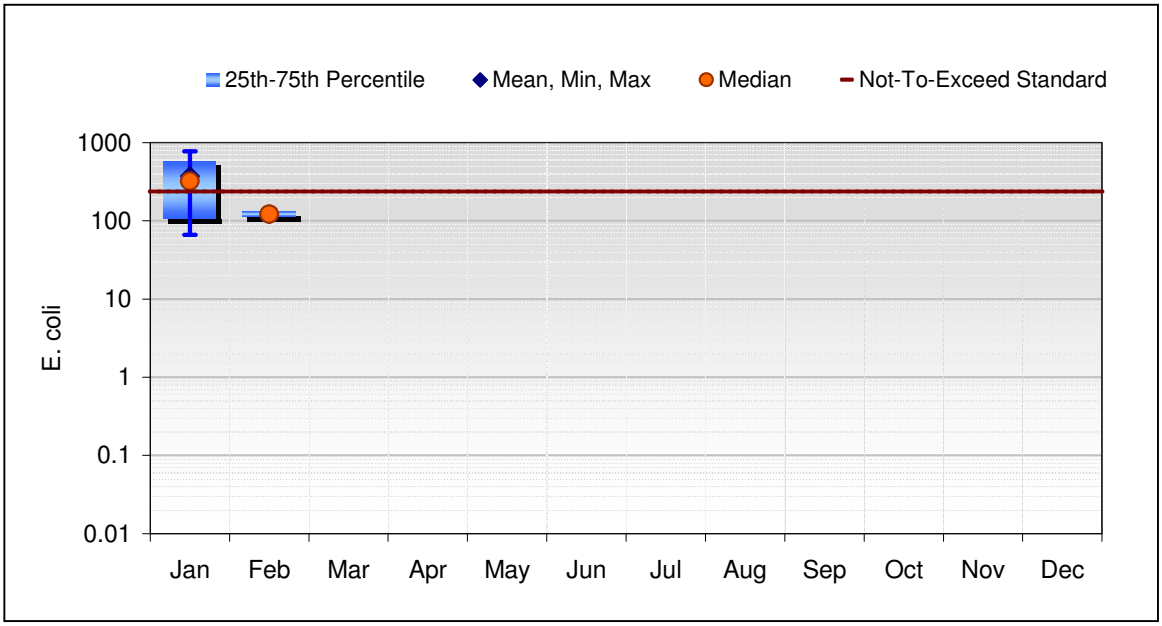

Figure 15. Camp Evers Creek at Carbonera Creek (#/100 mL) and Water Contact Recreation Maximum Water Quality Criteria (January 06, 2005- February 17, 2005)

Table 11 below provides summary statistics of the above figure. Based on two months of sampling, the water quality criterion was exceeded 33% of the time. There are insufficient data to determine impairment conditions for all months, but the impairment occurred in January.

Table 19. Camp Evers Creek at Carbonera Creek Data Summary (#/100 mL) and Exceedance of

Water Contact Recreation Maximum Objective

Summary Statistics (Data: 1/6/2005 to 2/17/2005)								
Month	**Mean**	**Median**	**Min**	**Max**	**25th**	**75th**	**XS:Count**	**XS%**
Jan	369	320	66	770	107	583	2:4	50%
Feb	122	122	104	140	113	131	0:2	0%
Mar	0	0	0	0	0	0	0:0	n/a
Apr	0	0	0	0	0	0	0:0	n/a
May	0	0	0	0	0	0	0:0	n/a
Jun	0	0	0	0	0	0	0:0	n/a
Jul	0	0	0	0	0	0	0:0	n/a
Aug	0	0	0	0	0	0	0:0	n/a
Sep	0	0	0	0	0	0	0:0	n/a
Oct	0	0	0	0	0	0	0:0	n/a
Nov	0	0	0	0	0	0	0:0	n/a
Dec	0	0	0	0	0	0	0:0	n/a
All Data	**287**	**130**	**66**	**770**	**108**	**425**	**2:6**	**33%**

Camp Evers Creek at Whispering Pines

Geometric Mean *E. coli* Water Quality Criteria (126 MPN/100 mL)

There are insufficient water quality data at this station from 1/6/2005 to 2/17/2005. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water *E. coli* Quality Criteria (235 MPN/100 mL)

Figure 11 below shows monthly *E.coli* concentrations for Carbonera Creek above Camp Evers Creek from 1/6/2005 to 2/17/2005. The mean concentrations do not exceed the water quality objective. However, as shown in the figure below, there are insufficient data to determine impairment conditions, because many months had no samples. The month of January in 2005 had four samples and the month of February in 2005 had two samples.

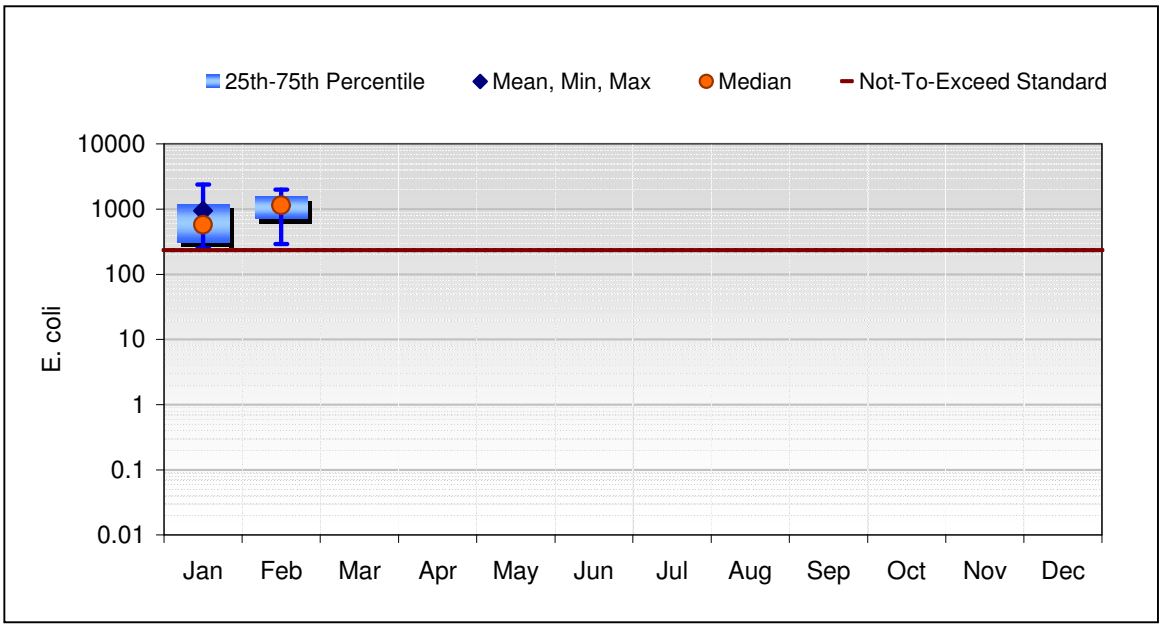

Figure 16. Camp Evers Creek at Whispering Pines (#/100 mL) and Water Contact Recreation Maximum Water Quality Criteria (January 06, 2005- February 17, 2005

Table 11 below provides summary statistics of the above figure. Based on two months of sampling, the water quality criterion was exceeded 100% of the time. There are insufficient data to determine impairment conditions for all months, but the impairment occurred in January and February.

Table 20. Camp Evers Creek at Whispering Pines Data Summary (#/100 mL) and Exceedance of Water Contact Recreation Maximum Objective

Summary Statistics (Data: 1/6/2005 to 2/17/2005)								
Month	**Mean**	**Median**	**Min**	**Max**	**25th**	**75th**	**XS:Count**	**XS%**
Jan	950	575	250	2400	310	1215	4:4	100%
Feb	1145	1145	290	2000	718	1573	2:2	100%
Mar	0	0	0	0	0	0	0:0	n/a
Apr	0	0	0	0	0	0	0:0	n/a
May	0	0	0	0	0	0	0:0	n/a
Jun	0	0	0	0	0	0	0:0	n/a
Jul	0	0	0	0	0	0	0:0	n/a
Aug	0	0	0	0	0	0	0:0	n/a
Sep	0	0	0	0	0	0	0:0	n/a
Oct	0	0	0	0	0	0	0:0	n/a
Nov	0	0	0	0	0	0	0:0	n/a
Dec	0	0	0	0	0	0	0:0	n/a
All Data	**1015**	**575**	**250**	**2400**	**300**	**1705**	**6:6**	**100%**

Camp Evers Creek at Cold Stream Way

Geometric Mean *E. coli* Water Quality Criteria (126 MPN/100 mL)

There are insufficient water quality data at this station from 1/6/2005 to 2/17/2005. No months have the minimum of five samples needed to calculate geometric means.

Maximum Water *E. coli* Quality Criteria (235 MPN/100 mL)

Figure 11 below shows monthly *E.coli* concentrations for Carbonera Creek above Camp Evers Creek from 1/6/2005 to 2/17/2005. The mean concentrations do not exceed the water quality objective. However, as shown in the figure below, there are insufficient data to determine impairment conditions, because many months either had no samples. The month of January in 2005 had four samples and the month of February in 2005 had two samples.

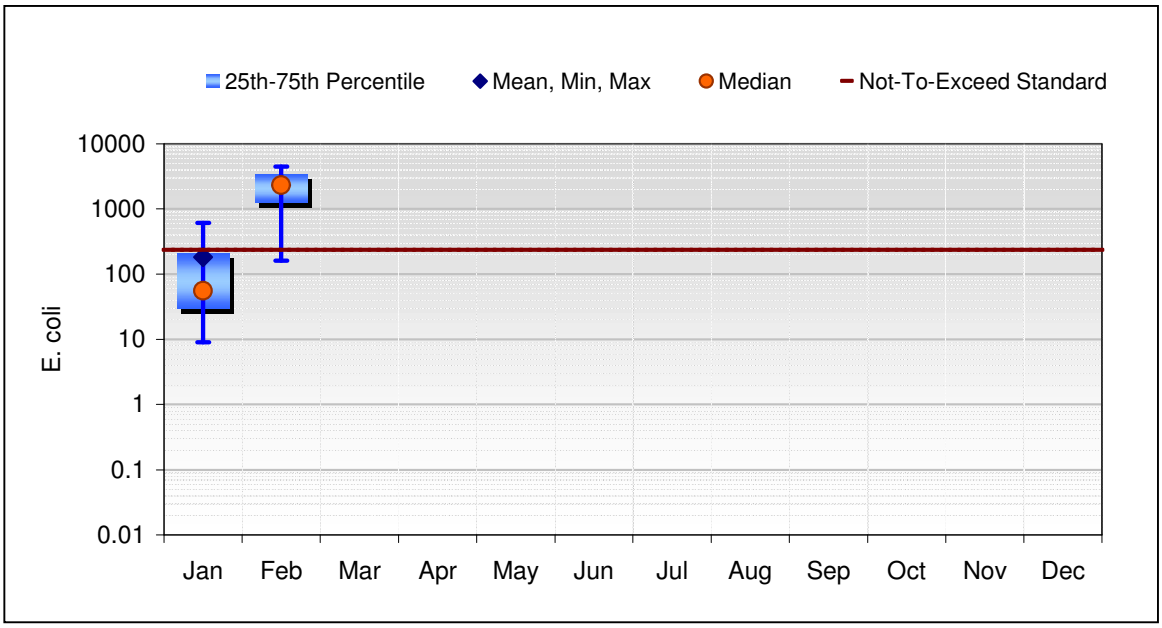

Figure 17. Camp Evers Creek at Cold Stream Way (#/100 mL) and Water Contact Recreation Maximum Water Quality Criteria (January 06, 2005- February 17, 2005)

Table 11 below provides summary statistics of the above figure. Based on two months of sampling, the water quality criterion was exceeded 33% of the time. There are insufficient data to determine impairment conditions for all months, but the impairment occurred in January and February.

Table 21. Camp Evers Creek at Cold Stream Way (#/100 mL) and Water Contact Recreation Maximum Water Quality Criteria (January 06, 2005- February 17, 2005)

Summary Statistics (Data: 1/6/2005 to 2/17/2005)								
Month	Mean	Median	Min	Max	25th	75th	XS:Count	XS%

Jan	183	56	9	610	29	209	1:4	25%
Feb	2330	2330	160	4500	1245	3415	1:2	50%
Mar	0	0	0	0	0	0	0:0	n/a
Apr	0	0	0	0	0	0	0:0	n/a
May	0	0	0	0	0	0	0:0	n/a
Jun	0	0	0	0	0	0	0:0	n/a
Jul	0	0	0	0	0	0	0:0	n/a
Aug	0	0	0	0	0	0	0:0	n/a
Sep	0	0	0	0	0	0	0:0	n/a
Oct	0	0	0	0	0	0	0:0	n/a
Nov	0	0	0	0	0	0	0:0	n/a
Dec	0	0	0	0	0	0	0:0	n/a
All Data	**898**	**118**	**9**	**4500**	**46**	**498**	**2:6**	**33%**

APPENDIX THREE. MICROBIAL SOURCE TRACKING DATA

This appendix presents microbial source tracking data results. The Table headings are now described.

Isolate number: A unique number that Dr. Samadpour gave to each isolate that was isolated from the water samples the County of Santa Cruz submitted.

Provider number: This number identifies what water sample was analyzed on a given date. In other words, if the County of Santa Cruz took four water samples on a given date, this column tells the reader which water sample was analyzed.

Stantum: The sampling station number
(A map of the sampling stations is provided in Figure XX..)

Note: The specific fecal coliform source.

Source: The category of the fecal coliform source

Rain 1: Rainfall within the previous 24-hour time period

Rain 3: Rainfall within the previous 72 hour time period

Rain 7: Rainfall within the previous 168-time period

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
65360	12802-003-1	003	avian	Bird	1/28/2002	70	1.845098	0	0.85	1.11
65361	12802-003-1	003	avian	Bird	1/28/2002	70	1.845098	0	0.85	1.11
65363	12802-003-2	003	avian	Bird	1/28/2002	60	1.7781513	0	0.85	1.11
65366	12802-003-3	003	avian	Bird	1/28/2002	110	2.0413927	0	0.85	1.11
65362	12802-003-2	003	dog	Dog	1/28/2002	60	1.7781513	0	0.85	1.11
65358	12802-003-1	003	human	Human	1/28/2002	70	1.845098	0	0.85	1.11
65364	12802-003-2	003	rodent	Rodent	1/28/2002	60	1.7781513	0	0.85	1.11
65365	12802-003-3	003	unknown	Unknown	1/28/2002	110	2.0413927	0	0.85	1.11
65359	12802-003-1	003	raccoon	Wildlife	1/28/2002	70	1.845098	0	0.85	1.11
65367	12802-003-3	003	deer	Wildlife	1/28/2002	110	2.0413927	0	0.85	1.11
65745	21202-003-4	003	human	Human	2/12/2002	40	1.60206	0	0	1.69
65746	21202-003-4	003	rodent	Rodent	2/12/2002	40	1.60206	0	0	1.69
65743	21202-003-1	003	unknown	Unknown	2/12/2002	20	1.30103	0	0	1.69
65744	21202-003-4	003	unknown	Unknown	2/12/2002	40	1.60206	0	0	1.69
66216	003-1	003	avian	Bird	3/25/2002	820	2.9138139	0	0.1	1.83
66219	003-2	003	septage/ ss/ human	Human	3/25/2002	700	2.845098	0	0.1	1.83
66220	003-3	003	human	Human	3/25/2002	770	2.8864907	0	0.1	1.83
66221	003-3	003	human	Human	3/25/2002	770	2.8864907	0	0.1	1.83
66222	003-3	003	human	Human	3/25/2002	770	2.8864907	0	0.1	1.83
66223	003-3	003	raw sewage	Human	3/25/2002	770	2.8864907	0	0.1	1.83
66224	003-4	003	human	Human	3/25/2002	610	2.7853298	0	0.1	1.83
66225	003-4	003	rodent	Rodent	3/25/2002	610	2.7853298	0	0.1	1.83
66214	003-1	003	unknown	Unknown	3/25/2002	820	2.9138139	0	0.1	1.83
66215	003-1	003	unknown	Unknown	3/25/2002	820	2.9138139	0	0.1	1.83
66217	003-2	003	unknown	Unknown	3/25/2002	700	2.845098	0	0.1	1.83

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
66218	003-2	003	unknown	Unknown	3/25/2002	700	2.845098	0	0.1	1.83
66226	003-4	003	beaver/ otter	Wildlife	3/25/2002	610	2.7853298	0	0.1	1.83
67331	003-1	003	Gull	Bird	5/21/2002	940	2.9731279	0	0.95	0.95
67335	003-3	003	avian	Bird	5/21/2002	710	2.8512583	0	0.95	0.95
67330	003-1	003	septage/ ss/ human	Human	5/21/2002	940	2.9731279	0	0.95	0.95
67332	003-1	003	raw sewage	Human	5/21/2002	940	2.9731279	0	0.95	0.95
67333	003-2	003	human	Human	5/21/2002	750	2.8750613	0	0.95	0.95
67334	003-2	003	human	Human	5/21/2002	750	2.8750613	0	0.95	0.95
67336	003-3	003	raw sewage	Human	5/21/2002	710	2.8512583	0	0.95	0.95
67337	003-3	003	unknown	Unknown	5/21/2002	710	2.8512583	0	0.95	0.95
71843	003-1	003	avian	Bird	12/10/2002	480	2.6812412	0.1	0.38	0.38
71845	003-1	003	avian	Bird	12/10/2002	480	2.6812412	0.1	0.38	0.38
71846	003-1	003	avian	Bird	12/10/2002	480	2.6812412	0.1	0.38	0.38
71847	003-1	003	Gull	Bird	12/10/2002	480	2.6812412	0.1	0.38	0.38
71849	003-1	003	avian	Bird	12/10/2002	480	2.6812412	0.1	0.38	0.38
71850	003-1	003	avian	Bird	12/10/2002	480	2.6812412	0.1	0.38	0.38
71852	003-2	003	Gull	Bird	12/10/2002	580	2.763428	0.1	0.38	0.38
71853	003-2	003	avian	Bird	12/10/2002	580	2.763428	0.1	0.38	0.38
71857	003-2	003	avian	Bird	12/10/2002	580	2.763428	0.1	0.38	0.38
71858	003-2	003	avian	Bird	12/10/2002	580	2.763428	0.1	0.38	0.38
71859	003-2	003	gull	Bird	12/10/2002	580	2.763428	0.1	0.38	0.38
71863	003-3	003	avian	Bird	12/10/2002	900	2.9542425	0.1	0.38	0.38
71865	003-3	003	avian	Bird	12/10/2002	900	2.9542425	0.1	0.38	0.38
71870	003-3	003	avian	Bird	12/10/2002	900	2.9542425	0.1	0.38	0.38
71872	003-3	003	Gull	Bird	12/10/2002	900	2.9542425	0.1	0.38	0.38
71851	003-1	003	horse	Horse	12/10/2002	480	2.6812412	0.1	0.38	0.38
71848	003-1	003	raw sewage	Human	12/10/2002	480	2.6812412	0.1	0.38	0.38
71854	003-2	003	human	Human	12/10/2002	580	2.763428	0.1	0.38	0.38
71855	003-2	003	human	Human	12/10/2002	580	2.763428	0.1	0.38	0.38
71856	003-2	003	human	Human	12/10/2002	580	2.763428	0.1	0.38	0.38
71864	003-3	003	human	Human	12/10/2002	900	2.9542425	0.1	0.38	0.38
71866	003-3	003	human	Human	12/10/2002	900	2.9542425	0.1	0.38	0.38
71867	003-3	003	human	Human	12/10/2002	900	2.9542425	0.1	0.38	0.38
71871	003-3	003	human	Human	12/10/2002	900	2.9542425	0.1	0.38	0.38
71842	003-1	003	unknown	Unknown	12/10/2002	480	2.6812412	0.1	0.38	0.38
71860	003-2	003	unknown	Unknown	12/10/2002	580	2.763428	0.1	0.38	0.38

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
71861	003-2	003	unknown	Unknown	12/10/2002	580	2.763428	0.1	0.38	0.38
71869	003-3	003	unknown	Unknown	12/10/2002	900	2.9542425	0.1	0.38	0.38
71844	003-1	003	otter	Wildlife	12/10/2002	480	2.6812412	0.1	0.38	0.38
71862	003-2	003	otter	Wildlife	12/10/2002	580	2.763428	0.1	0.38	0.38
72062	003-1	003	avian	Bird	12/18/2002	140	2.146128	0	0.58	14.28
72064	003-2	003	avian	Bird	12/18/2002	130	2.1139434	0	0.58	14.28
72066	003-2	003	Gull	Bird	12/18/2002	130	2.1139434	0	0.58	14.28
72068	003-2	003	Gull	Bird	12/18/2002	130	2.1139434	0	0.58	14.28
72070	003-3	003	avian	Bird	12/18/2002	270	2.4313638	0	0.58	14.28
72073	003-3	003	avian	Bird	12/18/2002	270	2.4313638	0	0.58	14.28
72069	003-3	003	dog	Dog	12/18/2002	270	2.4313638	0	0.58	14.28
72063	003-1	003	human	Human	12/18/2002	140	2.146128	0	0.58	14.28
72065	003-2	003	septage	Human	12/18/2002	130	2.1139434	0	0.58	14.28
72067	003-2	003	human	Human	12/18/2002	130	2.1139434	0	0.58	14.28
72071	003-3	003	human	Human	12/18/2002	270	2.4313638	0	0.58	14.28
72072	003-3	003	human	Human	12/18/2002	270	2.4313638	0	0.58	14.28
72058	003-1	003	unknown	Unknown	12/18/2002	140	2.146128	0	0.58	14.28
72059	003-1	003	unknown	Unknown	12/18/2002	140	2.146128	0	0.58	14.28
72060	003-1	003	unknown	Unknown	12/18/2002	140	2.146128	0	0.58	14.28
72061	003-1	003	unknown	Unknown	12/18/2002	140	2.146128	0	0.58	14.28
72402	003-1	003	avian	Bird	1/13/2003	360	2.5563025	0	0	1.8
72403	003-1	003	avian	Bird	1/13/2003	360	2.5563025	0	0	1.8
72406	003-2	003	avian	Bird	1/13/2003	300	2.4771213	0	0	1.8
72407	003-3	003	avian	Bird	1/13/2003	520	2.7160033	0	0	1.8
72408	003-3	003	avian	Bird	1/13/2003	520	2.7160033	0	0	1.8
72405	003-2	003	dog	Dog	1/13/2003	300	2.4771213	0	0	1.8
72409	003-3	003	dog	Dog	1/13/2003	520	2.7160033	0	0	1.8
72400	003-1	003	human	Human	1/13/2003	360	2.5563025	0	0	1.8
72401	003-1	003	human	Human	1/13/2003	360	2.5563025	0	0	1.8
72404	003-2	003	human	Human	1/13/2003	300	2.4771213	0	0	1.8
72738	003-1	003	avian	Bird	2/18/2003	140	2.146128	0	0	1.47
72739	003-1	003	Gull	Bird	2/18/2003	140	2.146128	0	0	1.47
72745	003-2	003	avian	Bird	2/18/2003	130	2.1139434	0	0	1.47
72747	003-3	003	gull	Bird	2/18/2003	270	2.4313638	0	0	1.47
72749	003-3	003	gull	Bird	2/18/2003	270	2.4313638	0	0	1.47
72750	003-3	003	Gull	Bird	2/18/2003	270	2.4313638	0	0	1.47
72796	003-1	003	Gull	Bird	2/18/2003	140	2.146128	0	0	1.47
72797	003-1	003	avian	Bird	2/18/2003	140	2.146128	0	0	1.47
72800	003-2	003	avian	Bird	2/18/2003	130	2.1139434	0	0	1.47
72801	003-2	003	avian	Bird	2/18/2003	130	2.1139434	0	0	1.47

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
72802	003-2	003	avian	Bird	2/18/2003	130	2.1139434	0	0	1.47
72803	003-2	003	avian	Bird	2/18/2003	130	2.1139434	0	0	1.47
72804	003-2	003	avian	Bird	2/18/2003	130	2.1139434	0	0	1.47
72805	003-3	003	avian	Bird	2/18/2003	270	2.4313638	0	0	1.47
72807	003-3	003	bovine	Cow	2/18/2003	270	2.4313638	0	0	1.47
72746	003-2	003	horse	Horse	2/18/2003	130	2.1139434	0	0	1.47
72740	003-1	003	septage	Human	2/18/2003	140	2.146128	0	0	1.47
72741	003-1	003	septage	Human	2/18/2003	140	2.146128	0	0	1.47
72744	003-2	003	human	Human	2/18/2003	130	2.1139434	0	0	1.47
72748	003-3	003	septage/ human	Human	2/18/2003	270	2.4313638	0	0	1.47
72798	003-1	003	human	Human	2/18/2003	140	2.146128	0	0	1.47
72799	003-1	003	human	Human	2/18/2003	140	2.146128	0	0	1.47
72803	003-2	003	human	Human	2/18/2003	130	2.1139434	0	0	1.47
72806	003-3	003	human	Human	2/18/2003	270	2.4313638	0	0	1.47
72808	003-3	003	human	Human	2/18/2003	270	2.4313638	0	0	1.47
72742	003-1	003	unknown	Unknown	2/18/2003	140	2.146128	0	0	1.47
72743	003-2	003	deer	Wildlife	2/18/2003	130	2.1139434	0	0	1.47
73154	003-1	003	gull	Bird	3/18/2003	1190	3.075547	0	0.39	2.08
73157	003-1	003	gull	Bird	3/18/2003	1190	3.075547	0	0.39	2.08
73159	003-2	003	gull	Bird	3/18/2003	1310	3.1172713	0	0.39	2.08
73161	003-2	003	Gull	Bird	3/18/2003	1310	3.1172713	0	0.39	2.08
73162	003-2	003	avian	Bird	3/18/2003	1310	3.1172713	0	0.39	2.08
73163	003-2	003	avian	Bird	3/18/2003	1310	3.1172713	0	0.39	2.08
73165	003-2	003	avian	Bird	3/18/2003	1310	3.1172713	0	0.39	2.08
73172	003-3	003	avian	Bird	3/18/2003	1130	3.0530784	0	0.39	2.08
73173	003-3	003	avian	Bird	3/18/2003	1130	3.0530784	0	0.39	2.08
73175	003-3	003	avian	Bird	3/18/2003	1130	3.0530784	0	0.39	2.08
73176	003-3	003	avian	Bird	3/18/2003	1130	3.0530784	0	0.39	2.08
73150	003-1	003	dog	Dog	3/18/2003	1190	3.075547	0	0.39	2.08
73164	003-2	003	dog	Dog	3/18/2003	1310	3.1172713	0	0.39	2.08
73168	003-2	003	canine	Dog	3/18/2003	1310	3.1172713	0	0.39	2.08
73174	003-3	003	canine	Dog	3/18/2003	1130	3.0530784	0	0.39	2.08
73151	003-1	003	septage	Human	3/18/2003	1190	3.075547	0	0.39	2.08
73152	003-1	003	septage	Human	3/18/2003	1190	3.075547	0	0.39	2.08
73166	003-2	003	septage	Human	3/18/2003	1310	3.1172713	0	0.39	2.08
73167	003-2	003	septage	Human	3/18/2003	1310	3.1172713	0	0.39	2.08
73169	003-3	003	human	Human	3/18/2003	1130	3.0530784	0	0.39	2.08
73178	003-3	003	human	Human	3/18/2003	1130	3.0530784	0	0.39	2.08
73155	003-1	003	rodent	Rodent	3/18/2003	1190	3.075547	0	0.39	2.08
73156	003-1	003	rodent	Rodent	3/18/2003	1190	3.075547	0	0.39	2.08
73160	003-2	003	rodent	Rodent	3/18/2003	1310	3.1172713	0	0.39	2.08
73153	003-1	003	unknown	Unknown	3/18/2003	1190	3.075547	0	0.39	2.08

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
73158	003-2	003	unknown	Unknown	3/18/2003	1310	3.1172713	0	0.39	2.08
73170	003-3	003	unknown	Unknown	3/18/2003	1130	3.0530784	0	0.39	2.08
73171	003-3	003	unknown	Unknown	3/18/2003	1130	3.0530784	0	0.39	2.08
73177	003-3	003	unknown	Unknown	3/18/2003	1130	3.0530784	0	0.39	2.08
85261	003 rep	003	avian	Bird	10/18/2003	700	2.845098		0	0
85262	003 rep	003	avian	Bird	10/18/2003	700	2.845098		0	0
85259	003	003	human	Human	10/18/2003	900	2.9542425		0	0
85257	003	003	rodent	Rodent	10/18/2003	900	2.9542425		0	0
85258	003	003	Unknown	Unknown	10/18/2003	900	2.9542425		0	0
85260	003 rep	003	Unknown	Unknown	10/18/2003	700	2.845098		0	0
84945	003-1	003	avian	Bird	10/21/2003	640	2.80618		0	0
84946	003-2	003	avian	Bird	10/21/2003	480	2.6812412		0	0
84947	003-2	003	gull	Bird	10/21/2003	480	2.6812412		0	0
84948	003-2	003	avian	Bird	10/21/2003	480	2.6812412		0	0
84943	003-1	003	raccoon	Wildlife	10/21/2003	640	2.80618		0	0
84944	003-1	003	raccoon	Wildlife	10/21/2003	640	2.80618		0	0
85578	003-1	003	avian	Bird	11/5/2003	260	2.4149733	0.39	0.39	1.2
85579	003-1	003	gull	Bird	11/5/2003	260	2.4149733	0.39	0.39	1.2
85583	003-2	003	avian	Bird	11/5/2003	100	2	0.39	0.39	1.2
85582	003-2	003	bov	Cow	11/5/2003	100	2	0.39	0.39	1.2
85577	003-1	003	canine	Dog	11/5/2003	260	2.4149733	0.39	0.39	1.2
85580	003-2	003	Unknown	Unknown	11/5/2003	100	2	0.39	0.39	1.2
85581	003-2	003	Unknown	Unknown	11/5/2003	100	2	0.39	0.39	1.2
86553	12-08-03-3B	003	gull	Bird	12/8/2003	740	2.8692317		1.31	1.64
86550	12-08-03-3A	003	rodent	Rodent	12/8/2003	820	2.9138139		1.31	1.64
86551	12-08-03-3A	003	rodent	Rodent	12/8/2003	820	2.9138139		1.31	1.64
86554	12-08-03-3B	003	rodent	Rodent	12/8/2003	740	2.8692317		1.31	1.64
86552	12-08-03-3B	003	Unknown	Unknown	12/8/2003	740	2.8692317		1.31	1.64
86549	12-08-03-3A	003	raccoon	Wildlife	12/8/2003	820	2.9138139		1.31	1.64
87450	003-2	003	gull	Bird	1/21/2004	20	1.30103		0	0
87452	003-3	003	avian	Bird	1/21/2004	30	1.4771213		0	0
87448	003-1	003	human	Human	1/21/2004	50	1.69897		0	0

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
87451	003-3	003	human	Human	1/21/2004	30	1.4771213		0	0
87447	003-1	003	rodent	Rodent	1/21/2004	50	1.69897		0	0
87449	003-2	003	rodent	Rodent	1/21/2004	20	1.30103		0	0
87446	003-1	003	raccoon	Wildlife	1/21/2004	50	1.69897		0	0
90658	003-1	003	avian	Bird	3/23/2004	300	2.4771213		0	0
90659	003-2	003	gull	Bird	3/23/2004	240	2.3802112		0	0
90660	003-2	003	avian	Bird	3/23/2004	240	2.3802112		0	0
90662	003-3	003	avian	Bird	3/23/2004	160	2.20412		0	0
90663	003-3	003	gull	Bird	3/23/2004	160	2.20412		0	0
90656	003-1	003	bovine	Cow	3/23/2004	300	2.4771213		0	0
90661	003-2	003	rodent	Rodent	3/23/2004	240	2.3802112		0	0
90664	003-3	003	rodent	Rodent	3/23/2004	160	2.20412		0	0
90657	003-1	003	Unknown	Unknown	3/23/2004	300	2.4771213		0	0
93173	003-1	003	gull	Bird	5/18/2004	290	2.462398		0	0
93176	003-2	003	avian	Bird	5/18/2004	290	2.462398		0	0
93178	003-2	003	avian	Bird	5/18/2004	290	2.462398		0	0
93181	003-3	003	avian	Bird	5/18/2004	290	2.462398		0	0
93182	003-3	003	avian	Bird	5/18/2004	290	2.462398		0	0
93177	003-2	003	human	Human	5/18/2004	290	2.462398		0	0
93180	003-3	003	human	Human	5/18/2004	290	2.462398		0	0
93174	003-1	003	Unknown	Unknown	5/18/2004	290	2.462398		0	0
93179	003-3	003	Unknown	Unknown	5/18/2004	290	2.462398		0	0
93175	003-1	003	raccoon	Wildlife	5/18/2004	290	2.462398		0	0
95419	6-15-04-003-1	003	avian	Bird	6/15/2004	1380	3.1398791	0	0	0
95422	6-15-04-003-2	003	avian	Bird	6/15/2004	1280	3.10721	0	0	0
95424	6-15-04-003-3	003	avian	Bird	6/15/2004	1320	3.1205739	0	0	0
95425	6-15-04-003-3	003	gull	Bird	6/15/2004	1320	3.1205739	0	0	0
95426	6-15-04-003-3	003	avian	Bird	6/15/2004	1320	3.1205739	0	0	0
95507	6-16-04-003-1	003	gull	Bird	6/15/2004	620	2.7923917	0	0	0
95508	6-16-04-003-1	003	gull	Bird	6/15/2004	620	2.7923917	0	0	0
95510	6-16-04-003-2	003	avian	Bird	6/15/2004	660	2.8195439	0	0	0
95511	6-16-04-003-2	003	avian	Bird	6/15/2004	660	2.8195439	0	0	0
95513	6-16-04-003-3	003	avian	Bird	6/15/2004	640	2.80618	0	0	0

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
95417	6-15-04-003-1	003	dog	Dog	6/15/2004	1380	3.1398791	0	0	0
95423	6-15-04-003-2	003	dog	Dog	6/15/2004	1280	3.10721	0	0	0
95506	6-16-04-003-1	003	horse	Horse	6/15/2004	620	2.7923917	0	0	0
95509	6-16-04-003-2	003	human	Human	6/15/2004	660	2.8195439	0	0	0
95418	6-15-04-003-1	003	rodent	Rodent	6/15/2004	1380	3.1398791	0	0	0
95512	6-16-04-003-3	003	rodent	Rodent	6/15/2004	640	2.80618	0	0	0
95514	6-16-04-003-3	003	Rodent	Rodent	6/15/2004	640	2.80618	0	0	0
95420	6-15-04-003-2	003	Unknown	Unknown	6/15/2004	1280	3.10721	0	0	0
95421	6-15-04-003-2	003	Unknown	Unknown	6/15/2004	1280	3.10721	0	0	0
95779	6-24-04-003-1	003	avian	Bird	6/24/2004	240	2.3802112	0	0	0
95782	6-24-04-003-1	003	gull	Bird	6/24/2004	240	2.3802112	0	0	0
95784	6-24-04-003-2	003	avian	Bird	6/24/2004	210	2.3222193	0	0	0
95787	6-24-04-003-3	003	gull	Bird	6/24/2004	220	2.3424227	0	0	0
95788	6-24-04-003-3	003	bovine	Cow	6/24/2004	220	2.3424227	0	0	0
95780	6-24-04-003-1	003	dog	Dog	6/24/2004	240	2.3802112	0	0	0
95781	6-24-04-003-1	003	dog	Dog	6/24/2004	240	2.3802112	0	0	0
95785	6-24-04-003-2	003	dog	Dog	6/24/2004	210	2.3222193	0	0	0
95783	6-24-04-003-2	003	rodent	Rodent	6/24/2004	210	2.3222193	0	0	0
95786	6-24-04-003-3	003	Unknown	Unknown	6/24/2004	220	2.3424227	0	0	0
97558	07-19-2004-003-1	003	avian	Bird	7/19/2004	350	2.544068	0	0	0
97559	07-19-2004-003-2	003	avian	Bird	7/19/2004	270	2.4313638	0	0	0
97564	07-19-2004-003-3	003	avian	Bird	7/19/2004	400	2.60206	0	0	0

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
97563	07-19-2004-003-3	003	canine	Dog	7/19/2004	400	2.60206	0	0	0
97556	07-19-2004-003-1	003	human	Human	7/19/2004	350	2.544068	0	0	0
97557	07-19-2004-003-1	003	human	Human	7/19/2004	350	2.544068	0	0	0
97565	07-19-2004-003-3	003	human	Human	7/19/2004	400	2.60206	0	0	0
97560	07-19-2004-003-2	003	Unknown	Unknown	7/19/2004	270	2.4313638	0	0	0
97561	07-19-2004-003-2	003	Unknown	Unknown	7/19/2004	270	2.4313638	0	0	0
97562	07-19-2004-003-2	003	unknown	Unknown	7/19/2004	270	2.4313638	0	0	0
97650	07-20-2004-003-2	003	avian	Bird	7/20/2004	290	2.462398	0	0	0
97651	07-20-2004-003-2	003	avian	Bird	7/20/2004	290	2.462398	0	0	0
97654	07-20-2004-003-3	003	avian	Bird	7/20/2004	240	2.3802112	0	0	0
97646	07-20-2004-003-1	003	canine	Dog	7/20/2004	210	2.3222193	0	0	0
97647	07-20-2004-003-1	003	sewage	Human	7/20/2004	210	2.3222193	0	0	0
97649	07-20-2004-003-2	003	human	Human	7/20/2004	290	2.462398	0	0	0
97653	07-20-2004-003-3	003	rodent	Rodent	7/20/2004	240	2.3802112	0	0	0
97652	07-20-2004-003-3	003	Unknown	Unknown	7/20/2004	240	2.3802112	0	0	0

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
97648	07-20-2004-003-1	003	Raccoon	Wildlife	7/20/2004	210	2.3222193	0	0	0
98751	8-02-04-003-1	003	avian	Bird	8/2/2004	160	2.20412	0	0	0
98753	8-02-04-003-1	003	avian	Bird	8/2/2004	160	2.20412	0	0	0
98754	8-02-04-003-2	003	gull	Bird	8/2/2004	190	2.2787536	0	0	0
98755	8-02-04-003-2	003	avian	Bird	8/2/2004	190	2.2787536	0	0	0
98756	8-02-04-003-2	003	avian	Bird	8/2/2004	190	2.2787536	0	0	0
98757	8-02-04-003-3	003	avian	Bird	8/2/2004	200	2.30103	0	0	0
98758	8-02-04-003-3	003	avian	Bird	8/2/2004	200	2.30103	0	0	0
98759	8-02-04-003-3	003	avian	Bird	8/2/2004	200	2.30103	0	0	0
98752	8-02-04-003-1	003	Raccoon	Wildlife	8/2/2004	160	2.20412	0	0	0
99407	8-04-04-003-1	003	avian	Bird	8/4/2004	170	2.2304489	0	0	0
99408	8-04-04-003-1	003	avian	Bird	8/4/2004	170	2.2304489	0	0	0
99409	8-04-04-003-1	003	gull	Bird	8/4/2004	170	2.2304489	0	0	0
99410	8-04-04-003-2	003	avian	Bird	8/4/2004	110	2.0413927	0	0	0
99411	8-04-04-003-2	003	gull	Bird	8/4/2004	110	2.0413927	0	0	0
99412	8-04-04-003-2	003	avian	Bird	8/4/2004	110	2.0413927	0	0	0
99414	8-04-04-003-3	003	avian	Bird	8/4/2004	60	1.7781513	0	0	0
99415	8-04-04-003-3	003	Unknown	Unknown	8/4/2004	60	1.7781513	0	0	0
99413	8-04-04-003-3	003	Raccoon	Wildlife	8/4/2004	60	1.7781513	0	0	0
99793	8-18-04-003-1	003	gull	Bird	8/18/2004	180	2.2552725	0	0	0
99794	8-18-04-003-1	003	gull	Bird	8/18/2004	180	2.2552725	0	0	0
99795	8-18-04-003-2	003	avian	Bird	8/18/2004	180	2.2552725	0	0	0
99797	8-18-04-003-2	003	gull	Bird	8/18/2004	180	2.2552725	0	0	0

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
99798	8-18-04-003-3	003	gull	Bird	8/18/2004	200	2.30103	0	0	0
99799	8-18-04-003-3	003	avian	Bird	8/18/2004	200	2.30103	0	0	0
99800	8-18-04-003-3	003	gull	Bird	8/18/2004	200	2.30103	0	0	0
99801	8-18-04-003-3	003	gull	Bird	8/18/2004	200	2.30103	0	0	0
99792	8-18-04-003-1	003	canine	Dog	8/18/2004	180	2.2552725	0	0	0
99796	8-18-04-003-2	003	canine	Dog	8/18/2004	180	2.2552725	0	0	0
102503	003-2	003	avian	Bird	9/21/2004	160	2.20412	0	0.02	0.02
102505	003-3	003	gull	Bird	9/21/2004	188	2.2741578	0	0.02	0.02
102506	003-3	003	gull	Bird	9/21/2004	188	2.2741578	0	0.02	0.02
102507	003-3	003	avian	Bird	9/21/2004	188	2.2741578	0	0.02	0.02
102117	003-1	003	human	Human	9/21/2004	176	2.2455127	0	0.02	0.02
102504	003-2	003	Unknown	Unknown	9/21/2004	160	2.20412	0	0.02	0.02
102118	003-1	003	Raccoon	Wildlife	9/21/2004	176	2.2455127	0	0.02	0.02
102119	003-1	003	raccoon	Wildlife	9/21/2004	176	2.2455127	0	0.02	0.02
65368	12802-022-1	022	avian	Bird	1/28/2002	120	2.0791812	0	0.85	1.11
65371	12802-022-2	022	Gull	Bird	1/28/2002	120	2.0791812	0	0.85	1.11
65372	12802-022-2	022	Gull	Bird	1/28/2002	120	2.0791812	0	0.85	1.11
65373	12802-022-2	022	avian	Bird	1/28/2002	120	2.0791812	0	0.85	1.11
65376	12802-022-3	022	avian	Bird	1/28/2002	100	2	0	0.85	1.11
65370	12802-022-1	022	human	Human	1/28/2002	120	2.0791812	0	0.85	1.11
65374	12802-022-3	022	septage/ ss/ human	Human	1/28/2002	100	2	0	0.85	1.11
65375	12802-022-3	022	septage/ ss/ human	Human	1/28/2002	100	2	0	0.85	1.11
65369	12802-022-1	022	unknown	Unknown	1/28/2002	120	2.0791812	0	0.85	1.11

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
65751	21202-022-2	022	duck	Bird	2/12/2002	24	1.3802112	0	0	1.69
65752	21202-022-3	022	avian	Bird	2/12/2002	12	1.0791812	0	0	1.69
65747	21202-022-1	022	feline	Cat	2/12/2002	16	1.20412	0	0	1.69
65749	21202-022-2	022	Bovine	Cow	2/12/2002	24	1.3802112	0	0	1.69
65750	21202-022-2	022	swine	Unknown	2/12/2002	24	1.3802112	0	0	1.69
65748	21202-022-1	022	beaver/ otter	Wildlife	2/12/2002	16	1.20412	0	0	1.69
66232	022-3	022	avian	Bird	3/25/2002	72	1.8573325	0	0.1	1.83
66230	022-3	022	dog	Dog	3/25/2002	72	1.8573325	0	0.1	1.83
66234	022-4	022	dog	Dog	3/25/2002	56	1.748188	0	0.1	1.83
66227	022-1	022	human	Human	3/25/2002	76	1.8808136	0	0.1	1.83
66228	022-1	022	raw sewage	Human	3/25/2002	76	1.8808136	0	0.1	1.83
66229	022-1	022	raw sewage	Human	3/25/2002	76	1.8808136	0	0.1	1.83
66233	022-4	022	rodent	Rodent	3/25/2002	56	1.748188	0	0.1	1.83
66235	022-4	022	rodent	Rodent	3/25/2002	56	1.748188	0	0.1	1.83
66546	022-2	022	rodent	Rodent	3/25/2002	52	1.7160033	0	0.1	1.83
66547	022-2	022	rodent	Rodent	3/25/2002	52	1.7160033	0	0.1	1.83
66231	022-3	022	otter	Wildlife	3/25/2002	72	1.8573325	0	0.1	1.83
67343	022-2	022	avian	Bird	5/21/2002	300	2.4771213	0	0.95	0.95
67345	022-3	022	avian	Bird	5/21/2002	190	2.2787536	0	0.95	0.95
67338	022-1	022	raw sewage	Human	5/21/2002	320	2.50515	0	0.95	0.95
67339	022-1	022	rodent	Rodent	5/21/2002	320	2.50515	0	0.95	0.95
67340	022-1	022	unknown	Unknown	5/21/2002	320	2.50515	0	0.95	0.95
67341	022-1	022	unknown	Unknown	5/21/2002	320	2.50515	0	0.95	0.95
67344	022-3	022	unknown	Unknown	5/21/2002	190	2.2787536	0	0.95	0.95
67342	022-2	022	otter	Wildlife	5/21/2002	300	2.4771213	0	0.95	0.95
71834	022-1	022	avian	Bird	12/10/2002	320	2.50515	0.1	0.38	0.38
71835	022-1	022	avian	Bird	12/10/2002	320	2.50515	0.1	0.38	0.38
71839	022-3	022	avian	Bird	12/10/2002	190	2.2787536	0.1	0.38	0.38
71840	022-3	022	Bovine	Cow	12/10/2002	190	2.2787536	0.1	0.38	0.38
71841	022-3	022	Bovine	Cow	12/10/2002	190	2.2787536	0.1	0.38	0.38
71836	022-1	022	human	Human	12/10/2002	320	2.50515	0.1	0.38	0.38
71837	022-3	022	otter	Wildlife	12/10/2002	190	2.2787536	0.1	0.38	0.38
72087	022-3	022	avian	Bird	12/18/2002	88	1.9444827	0	0.58	14.28
72088	022-3	022	bovine	Cow	12/18/2002	88	1.9444827	0	0.58	14.28

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
72078	022-1	022	human	Human	12/18/2002	76	1.8808136	0	0.58	14.28
72083	022-2	022	raw sewage	Human	12/18/2002	68	1.8325089	0	0.58	14.28
72084	022-2	022	human	Human	12/18/2002	68	1.8325089	0	0.58	14.28
72074	022-1	022	unknown	Unknown	12/18/2002	76	1.8808136	0	0.58	14.28
72075	022-1	022	unknown	Unknown	12/18/2002	76	1.8808136	0	0.58	14.28
72076	022-1	022	unknown	Unknown	12/18/2002	76	1.8808136	0	0.58	14.28
72077	022-1	022	unknown	Unknown	12/18/2002	76	1.8808136	0	0.58	14.28
72079	022-2	022	unknown	Unknown	12/18/2002	68	1.8325089	0	0.58	14.28
72080	022-2	022	unknown	Unknown	12/18/2002	68	1.8325089	0	0.58	14.28
72081	022-2	022	unknown	Unknown	12/18/2002	68	1.8325089	0	0.58	14.28
72082	022-2	022	unknown	Unknown	12/18/2002	68	1.8325089	0	0.58	14.28
72085	022-3	022	unknown	Unknown	12/18/2002	88	1.9444827	0	0.58	14.28
72086	022-3	022	unknown	Unknown	12/18/2002	88	1.9444827	0	0.58	14.28
72089	022-3	022	Unknown	Unknown	12/18/2002	88	1.9444827	0	0.58	14.28
72414	022-2	022	avian	Bird	1/13/2003	112	2.049218	0	0	1.8
72416	022-3	022	avian	Bird	1/13/2003	144	2.1583625	0	0	1.8
72417	022-3	022	avian	Bird	1/13/2003	144	2.1583625	0	0	1.8
72411	022-1	022	canine	Dog	1/13/2003	136	2.1335389	0	0	1.8
72415	022-2	022	horse	Horse	1/13/2003	112	2.049218	0	0	1.8
72410	022-1	022	human	Human	1/13/2003	136	2.1335389	0	0	1.8
72412	022-1	022	septage/ human	Human	1/13/2003	136	2.1335389	0	0	1.8
72413	022-2	022	human	Human	1/13/2003	112	2.049218	0	0	1.8
72418	022-3	022	unknown	Unknown	1/13/2003	144	2.1583625	0	0	1.8
72728	022-1	022	avian	Bird	2/18/2003	76	1.8808136	0	0	1.47
72730	022-2	022	avian	Bird	2/18/2003	68	1.8325089	0	0	1.47
72733	022-2	022	avian	Bird	2/18/2003	68	1.8325089	0	0	1.47
72737	022-3	022	avian	Bird	2/18/2003	88	1.9444827	0	0	1.47
72784	022-1	022	avian	Bird	2/18/2003	76	1.8808136	0	0	1.47
72785	022-1	022	avian	Bird	2/18/2003	76	1.8808136	0	0	1.47
72786	022-1	022	avian	Bird	2/18/2003	76	1.8808136	0	0	1.47
72787	022-1	022	avian	Bird	2/18/2003	76	1.8808136	0	0	1.47
72791	022-2	022	avian	Bird	2/18/2003	68	1.8325089	0	0	1.47

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
72792	022-3	022	avian	Bird	2/18/2003	88	1.9444827	0	0	1.47
72795	022-3	022	avian	Bird	2/18/2003	88	1.9444827	0	0	1.47
72727	022-1	022	Bovine	Cow	2/18/2003	76	1.8808136	0	0	1.47
72794	022-3	022	bovine	Cow	2/18/2003	88	1.9444827	0	0	1.47
72729	022-1	022	dog	Dog	2/18/2003	76	1.8808136	0	0	1.47
72731	022-2	022	human	Human	2/18/2003	68	1.8325089	0	0	1.47
72732	022-2	022	septage/ human	Human	2/18/2003	68	1.8325089	0	0	1.47
72734	022-3	022	raw sewage	Human	2/18/2003	88	1.9444827	0	0	1.47
72788	022-2	022	raw sewage	Human	2/18/2003	68	1.8325089	0	0	1.47
72789	022-2	022	raw sewage	Human	2/18/2003	68	1.8325089	0	0	1.47
72790	022-2	022	septage/ human	Human	2/18/2003	68	1.8325089	0	0	1.47
72793	022-3	022	human	Human	2/18/2003	88	1.9444827	0	0	1.47
72735	022-3	022	rodent	Rodent	2/18/2003	88	1.9444827	0	0	1.47
72736	022-3	022	rodent	Rodent	2/18/2003	88	1.9444827	0	0	1.47
73184	022-1	022	avian	Bird	3/18/2003	60	1.7781513	0	0.39	2.08
73189	022-2	022	avian	Bird	3/18/2003	70	1.845098	0	0.39	2.08
73192	022-2	022	avian	Bird	3/18/2003	70	1.845098	0	0.39	2.08
73193	022-2	022	avian	Bird	3/18/2003	70	1.845098	0	0.39	2.08
73180	022-1	022	dog	Dog	3/18/2003	60	1.7781513	0	0.39	2.08
73181	022-1	022	dog	Dog	3/18/2003	60	1.7781513	0	0.39	2.08
73185	022-1	022	dog	Dog	3/18/2003	60	1.7781513	0	0.39	2.08
73179	022-1	022	septage/ human	Human	3/18/2003	60	1.7781513	0	0.39	2.08
73188	022-2	022	human	Human	3/18/2003	70	1.845098	0	0.39	2.08
73199	022-3	022	human	Human	3/18/2003	50	1.69897	0	0.39	2.08
73186	022-1	022	rodent	Rodent	3/18/2003	60	1.7781513	0	0.39	2.08
73187	022-1	022	rodent	Rodent	3/18/2003	60	1.7781513	0	0.39	2.08
73195	022-3	022	rodent	Rodent	3/18/2003	50	1.69897	0	0.39	2.08
73183	022-1	022	unknown	Unknown	3/18/2003	60	1.7781513	0	0.39	2.08
73191	022-2	022	unknown	Unknown	3/18/2003	70	1.845098	0	0.39	2.08
73182	022-1	022	raccoon	Wildlife	3/18/2003	60	1.7781513	0	0.39	2.08
73190	022-2	022	otter	Wildlife	3/18/2003	70	1.845098	0	0.39	2.08
73194	022-2	022	otter	Wildlife	3/18/2003	70	1.845098	0	0.39	2.08
73196	022-3	022	otter	Wildlife	3/18/2003	50	1.69897	0	0.39	2.08
73197	022-3	022	otter	Wildlife	3/18/2003	50	1.69897	0	0.39	2.08
73198	022-3	022	raccoon	Wildlife	3/18/2003	50	1.69897	0	0.39	2.08
73200	022-3	022	deer	Wildlife	3/18/2003	50	1.69897	0	0.39	2.08
73201	022-3	022	otter	Wildlife	3/18/2003	50	1.69897	0	0.39	2.08
73202	022-3	022	otter	Wildlife	3/18/2003	50	1.69897	0	0.39	2.08

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
85264	022	022	avian	Bird	10/18/2003	72	1.8573325		0	0
85266	022 rep	022	avian	Bird	10/18/2003	92	1.9637878		0	0
85267	022 rep	022	avian	Bird	10/18/2003	92	1.9637878		0	0
85265	022 rep	022	canine	Dog	10/18/2003	92	1.9637878		0	0
85263	022	022	horse	Horse	10/18/2003	72	1.8573325		0	0
84949	022-1	022	avian	Bird	10/21/2003	10	1		0	0
84954	022-2	022	avian	Bird	10/21/2003	60	1.7781513		0	0
84950	022-1	022	canine	Dog	10/21/2003	10	1		0	0
84953	022-2	022	canine	Dog	10/21/2003	60	1.7781513		0	0
84951	022-2	022	rodent	Rodent	10/21/2003	60	1.7781513		0	0
84952	022-2	022	rodent	Rodent	10/21/2003	60	1.7781513		0	0
85585	022-1	022	avian	Bird	11/5/2003	60	1.7781513	0.39	0.39	1.2
85586	022-1	022	avian	Bird	11/5/2003	60	1.7781513	0.39	0.39	1.2
85588	022-2	022	avian	Bird	11/5/2003	60	1.7781513	0.39	0.39	1.2
85589	022-2	022	human	Human	11/5/2003	60	1.7781513	0.39	0.39	1.2
85584	022-1	022	rodent	Rodent	11/5/2003	60	1.7781513	0.39	0.39	1.2
85587	022-2	022	rodent	Rodent	11/5/2003	60	1.7781513	0.39	0.39	1.2
86555	12-08-03-22A	022	avian	Bird	12/8/2003	150	2.1760913		1.31	1.64
86556	12-08-03-22A	022	gull	Bird	12/8/2003	150	2.1760913		1.31	1.64
86558	12-08-03-22B	022	avian	Bird	12/8/2003	200	2.30103		1.31	1.64
86557	12-08-03-22A	022	sewage	Human	12/8/2003	150	2.1760913		1.31	1.64
86559	12-08-03-22B	022	sewage	Human	12/8/2003	200	2.30103		1.31	1.64
86560	12-08-03-22B	022	raccoon	Wildlife	12/8/2003	200	2.30103		1.31	1.64
97655	07-20-2004-022-1	022	avian	Bird	7/20/2004	44	1.6434527	0	0	0
97656	07-20-2004-022-1	022	avian	Bird	7/20/2004	44	1.6434527	0	0	0
97660	07-20-2004-022-2	022	avian	Bird	7/20/2004	64	1.80618	0	0	0
97661	07-20-2004-022-2	022	avian	Bird	7/20/2004	64	1.80618	0	0	0
97662	07-20-2004-022-3	022	avian	Bird	7/20/2004	64	1.80618	0	0	0
97664	07-20-2004-022-3	022	avian	Bird	7/20/2004	64	1.80618	0	0	0

Isolate.	Provider Sample	Stantum	Note	Source	Sample Date	Fe. Coli	Log FC	RAIN-1	RAIN-3	RAIN-7
97658	07-20-2004-022-2	022	Rodent	Rodent	7/20/2004	64	1.80618	0	0	0
97659	07-20-2004-022-2	022	rodent	Rodent	7/20/2004	64	1.80618	0	0	0
97657	07-20-2004-022-1	022	Unknown	Unknown	7/20/2004	44	1.6434527	0	0	0
97663	07-20-2004-022-3	022	Unknown	Unknown	7/20/2004	64	1.80618	0	0	0
99416	8-04-04-022-1	022	avian	Bird	8/4/2004	72	1.8573325	0	0	0
99417	8-04-04-022-1	022	avian	Bird	8/4/2004	72	1.8573325	0	0	0
99418	8-04-04-022-1	022	avian	Bird	8/4/2004	72	1.8573325	0	0	0
99421	8-04-04-022-2	022	avian	Bird	8/4/2004	68	1.8325089	0	0	0
99422	8-04-04-022-2	022	avian	Bird	8/4/2004	68	1.8325089	0	0	0
99423	8-04-04-022-3	022	avian	Bird	8/4/2004	80	1.90309	0	0	0
99424	8-04-04-022-3	022	avian	Bird	8/4/2004	80	1.90309	0	0	0
99419	8-04-04-022-2	022	Unknown	Unknown	8/4/2004	68	1.8325089	0	0	0
99420	8-04-04-022-2	022	Raccoon	Wildlife	8/4/2004	68	1.8325089	0	0	0
99425	8-04-04-022-3	022	Raccoon	Wildlife	8/4/2004	80	1.90309	0	0	0

APPENDIX FOUR. CONDUCTIVITY ANALYSIS TO DETERMINE ESTUARY BOUNDARY

Santa Cruz County Environmental Health Services has sampled the Estuary for conductivity. The stations sampled for conductivity are shown in the figure below and are used to determine the Estuary boundary. The figure below shows stations sampled for conductivity.

[Insert Figure showing stations sampled for conductivity]

Figure 1. Stations Sampled for Conductivity

Table 1. Summary of Santa Cruz County Conductivity Data

Station	Number of Samples	Minimum	Average	Maximum	Start Date	End Date
San Lorenzo River Lagoon @ Trestle	170	4.12	13,136	52,600	10/29/01	02/28/05
San Lorenzo River Lagoon @ Broadway/Laurel Bridge	172	2.86	4,145	44,400	10/29/01	02/28/05
San Lorenzo River @ Soquel Avenue Bridge	29	163	697	4,400	11/24/86	02/19/97
San Lorenzo River @ Water Street Bridge	49	7.72	403	1,000	06/28/88	10/16/01
San Lorenzo River @ Sycamore Grove	229	0.415	402	4,690	10/29/01	07/11/05

Branciforte Creek @ San Lorenzo River	4	404	1,036	3,240	12/20/00	02/26/02
Branciforte Creek @ Carbonera Creek	7	299	484	657	06/28/88	01/24/02
Branciforte Creek @ Isbel Drive	232	100	509	980	08/44/77	06/15/05
Carbonera Creek @ Branciforte Creek	4	435	472	500	10/24/03	10/08/04

Staff concluded the Soquel Avenue Bridge is the approximate inland Estuary boundary. The next further inland station, "San Lorenzo River @ Water Street," exhibits nonsaline conditions. Table 2-1 above indicates: 1) decreased conductivity concentrations relative to the downstream Broadway/Laurel Street Bridge station and 2) increased conductivity relative to the Sycamore Grove station. Therefore, this station is subject to stagnate flows. Bacterial growth may be a factor contributing high concentrations at this station.

(One station, Branciforte Creek @ San Lorenzo River had high conductivity. This is attributed to one conductivity sample of 3,240 mg/L. This station only had four total samples. Staff considers this one high reading to be an anomaly.)

APPENDIX FIVE. USE ATTAINABILITY ANALYSIS